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IRRADIATION OF NASOPHARYNGEAL LYMPHOID TISSUE: AN EVALUATION

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THE PROBLEM of pharyngeal lymphoid tissue has been with otolaryngologists for a long time. For years this tissue has had an importance in the oropharynx in connection with certain types of chronic sore throat, as a factor in excessive secretion in the throat, and it has been regarded with suspicion in the presence of any systemic disease in which a focus of infection might play an important role.

No one knows the real meaning of lymphoid tissue. After removal of the tonsils and adenoids of the young child, this tissue has been observed to become prominent on the pharyngeal wall as "granules" and laterally as bands. Lillie [1] and others have referred to this reaction as compensatory, suggesting that the lymphoid tissue has a purposeful place and that this new distribution is an attempt on the part of nature to replace at least in part that which was surgically removed.

There are references in the literature [2] to many other possible causes of pharyngeal lymphoid hyperplasia, such as local infection, mouth breathing, bathing of the pharynx in secretions from the sinuses or from the respiratory tract below, tobacco smoke, exposure to dust and gases in certain industries, endocrine disorders, metabolic disturbances and dietary errors.

Lately otolaryngologists have had their attention focused on the importance of nasopharyngeal lymphoid tissue exclusive of the mass of adenoids which they are accustomed to remove surgically. The lymphoid tissue of Rosenmüller's fossa and the nodules which occur in the mucosa of the orifice of the eustachian tube and within its lining are now considered to play an important role in a common type of early hearing loss in children.

Read before the Middle Section meeting of the American Laryngological, Rhinological and Otological Society, Inc., Indianapolis, Jan. 17, 1945.

1. Lillie, H. I.: The Clinical Significance of Compensatory Granular Pharyngitis, Arch. Otolaryng. **24**:319-324 (Sept.) 1936.

2. Schenck, H. P.: Chronic Infections in the Pharynx: A Pathological Study, Arch. Otolaryng. **24**:299-308 (Sept.) 1936. Marcotte, R. H.: Chronic Granular Pharyngitis, Ann. Otol., Rhin. & Laryng. **51**:400-411 (June) 1942.

In 1939 Crowe and Baylor [3] renewed the interest of physicians in this tissue. Their first report and subsequent ones of their co-workers [4] indicated that:

1. There is in children 8 to 14 years of age a high incidence (nearly 40 per cent) of impairment of thresholds for some or all of the tones above C4; i. e., for frequencies higher than 2048 cycles per second.

2. A common cause of this early hearing loss is to be found in catarrhal changes of the middle ear which originate from infected lymphoid tissue in the nasopharynx. The pathogenesis of these changes was described as follows:

> . . . Large adenoids or lymphoid nodules near the nasopharyngeal orifice of the Eustachian tube interfere with normal ventilation of the middle ear. This interference with the normal ventilation results, by absorption of some of the contained air, in a middle-ear pressure chronically less than atmospheric. The pressure difference itself may cause a slight impairment of hearing as well as retraction of the tympanic membrane, but the important result is mucosal hyperemia and edema. If the condition persists, mucosal hyperplasia and fibrosis develop. The mucosal changes, together with the exudate and transudate that accumulate in the middle ear, interfere with the transmission of sound waves to the inner ear. In contrast to the classical idea of the effect of catarrhal otitis media on hearing, we find that the perception of high tones, rather than of low tones, is usually impaired first.

(An interesting experiment was carried out by Loch [5] on himself. A soft rubber balloon was inflated in his nasopharynx to occlude the pharyngeal orifices of his eustachian tubes. Within one and a half hours audiometric tests showed that this occlusion caused first and mostly an impairment of hearing of high tones. Later the hearing of middle and low tones became slightly impaired. Immediately after the balloon was removed and a positive Valsalva procedure and swallowing were practiced, the hearing returned to the values obtained before placement of the balloon. Loch expressed the belief that this hearing impairment can be explained only as a result of pressure changes in the middle ear.)

3. Hyperplasia of nasopharyngeal lymphoid tissue is common in children. A majority of those who have had their tonsils and adenoids removed will, when examined, be found to have adenoid masses or hyperplasia of the lymphoid tissue in the fossa of Rosenmüller and in the region of the nasopharyngeal orifice of one or both eustachian tubes.

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3. Crowe, S. J., and Baylor, J. W.: The Prevention of Deafness, J. A. M. A. **112**:585-590 (Feb. 18) 1939.

4. Guild, S. R.; Polvogt, L. M.; Sanstead, H. R.; Loch, W. E.; Langer, E.; Robbins, M. H., and Parr, W. A.: Impaired Hearing in School Children, Laryngoscope **50**:731-746 (Aug.) 1940. Crowe, S. J.; Guild, S. R.; Langer, E.; Loch, W. E. and Robbins, M. H.: Impaired Hearing in School Children, ibid. **52**:790-804 (Oct.) 1942.

5. Loch, W. E.: The Effect on Hearing of Experimental Occlusion of the Eustachian Tube in Man, Ann. Otol., Rhin. & Laryng. **51**:396-405 (June) 1942.

4. Irradiation of this tissue with a 2 gram minute dose of radon to each side is an effective method of causing regression of a small amount of the lymphoid tissue. This amount of irradiation has no harmful effect on the nasopharyngeal structures.

5. Children with impairment of hearing for high tones could have lesions other than those secondary to tubal occlusion caused by excessive lymphoid tissue. Treatment in all cases is advisable, however, as a therapeutic test if the nasopharynx is not normal in appearance.

6. The most immediate benefit from radon therapy was found in those children who had impaired hearing for all tones or difficulty in understanding the spoken voice.

7. Rechecking every few months is important.

RECORDED INSTANCES OF USE OF ROENTGEN RAYS, RADON AND RADIUM TO REMOVE LYMPHOID TISSUES OF THE NASOPHARYNX

Irradiation of pharyngeal lymphoid tissue is not new. Reports of this form of therapy have appeared in the literature for over twenty years. Jarvis [6] in 1923 reported some observations on the effect of small doses of roentgen applied rays to the nasopharynx in patients who complained of stuffy ears and impaired hearing. He was enthusiastic about the good results in a small group of cases.

More recently O'Brien [7] reported improvement by roentgen therapy in 73 of 140 cases of chronic catarrhal deafness in which there were varying degrees of hearing impairment.

Roentgen irradiation of pharyngeal lymphoid tissue for the relief of sore throats and hypersecretion has also been reported frequently. Eagle and Reeves [8] recommended it from a large series of cases reported in 1936.

Fricke and Pastore [9] have reported the use of radium on lateral pharyngeal bands in 24 patients treated during a three year period, 1938 to 1941. The treatment was successful in all. All had fewer colds, less severe sore throats and improved general health. "There have been no reactions or injurious effects." (During this same period they treated 83 patients for hypertrophied lymphoid tissue in Rosenmüller's fossa.)

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6. Jarvis, D. C.: Effect of Small Doses of Roentgen Rays in Certain Forms of Impaired Hearing, Am. J. Roentgenol. **10**:201-202 (March) 1923.

7. O'Brien, F. W.: The Treatment of Selected Cases of Chronic Catarrhal Deafness by X-Ray, Radiology **28**:1-4 (Jan.) 1937.

8. Eagle, W. E., and Reeves, R. J.: The Treatment of Lymphoid Hypertrophies and Infections of the Pharynx and Nasopharynx by Irradiation, South. M. J. **29**:159-163 (Feb.) 1936.

9. Fricke, R. E., and Pastore, P. N.: The Radium Treatment of Granular or Hypertrophied Lateral Pharyngeal Bands, Proc. Staff Meet., Mayo Clin. **18**:307-312 (Aug. 25) 1943.

Crowe [10] in a recent report stated that radon had been used on nasopharyngeal lymphoid tissue for fifteen years at the Johns Hopkins Hospital.

HISTOLOGIC EFFECT OF IRRADIATION OF LYMPHOID TISSUE

Schenck [11] has made a study of the effect of irradiation of lymphoid tissue in human subjects. He used three different but comparable technics. In one group roentgen rays were used; in another, roentgen ray, and radium, and in a third, radium alone. Tissue was obtained for biopsy two and four weeks later and again at six months. The most marked changes noted were as follows:

1. The epithelial cells became swollen and often vacuolated.

2. Minute hemorrhages occurred about and within the nodules indicating an effect of the irradiation on the epithelium of the capillaries.

3. Detachment of ciliated cells was not uncommon.

4. Freeing of the endothelium of the lymph capillaries was noted. This was a striking effect.

5. There was little alteration in the adult lymphocytes, but the young lymphocytes presented marked nuclear disturbances or had undergone dissolution so that only cell fragments remained.

6. The earliest and most profound changes were seen in the germinal centers—many cells appeared to have undergone various degrees of liquefaction.

In tissue removed six months after irradiation there was a reappearance of lymphocytes, indicating regeneration, but germinal centers did not reappear in this interval. There was condensation of reticular network, also diminution of fibrous tissue.

An apparent increase in the number of lymphatic channels was a striking and unexpected effect.

Schenck commented:

> . . . It is well to emphasize therefore that, although our main interest may be in the effects of irradiation on lymphatic structures, there is also a concomitant and perhaps equally important effect upon the adjacent tissues. Pendergrass and Hodes have pointed out the advantages of irradiating infections through portals large enough to extend beyond the border of infection, stating that this induces an increased blood flow not only in the periphery of the lesion but, what may be more important, in the larger area of normal tissue about the infection. Thus, an original area of passive hyperemia is transformed into an area of active

10. Crowe, S. J.: The Local Use of Sulfadiazine Solution, Radon, Tyrothricin and Penicillin in Otolaryngology, Ann. Otol., Rhin. & Laryng. **53**:227-241 (June) 1944.

11. Schenck, H. P.: The Influence of Nasopharyngeal Hyperplasia on the Ear: Histologic Examination of Hyperplastic Lymph Follicles After Irradiation, Laryngoscope **51**:780-790 (Aug.) 1941.

hyperemia. Increased blood supply not only increases the temperature and local concentration of electrolytes but also decreases edema by increasing lymphatic flow.

Crowe [10] has described what he believes to be the important effect of irradiation as follows:

> . . . The action of the irradiation is to inhibit mitosis in the germinal centers and thus stop the formation of new lymphocytes. Observation of hyperplastic lymphoid tissue under this treatment leads us to believe that lymphocytes, like the skin cells, have a brief life cycle, probably not more than two weeks. Under irradiation treatment no new lymphocytes are formed to replace those discarded and the mass gradually shrinks and finally disappears, leaving the nasopharynx covered with smooth mucous membrane not unlike that on the nasal septum. If the dose is just right the result is perfect and there is never any recurrence.

DOSAGES OF RADON OR RADIUM

Crowe's observations have been made on patients who have received 2 gram minutes of irradiation, the gamma rays in a large quantity of radon (up to 1,000 millicuries) being utilized. With 1,000 millicuries an application of two minutes to the side provides the desired dose. This makes the treatment extremely simple from the standpoint of the time involved. However, radon is not generally available, and in but few institutions can it be obtained in that amount. The Radium Emanation Corporation, New York, rents an applicator of 100 millicurie strength,[12] which is shipped by express with specifications given as to exact dosage according to its strength, which of course decreases with time. A forty minute application to the side would be necessary to get a 2 gram minute dosage with the applicator at full 100 millicurie strength.

Farrior and Richardson [13] reported the use of an applicator containing 50 mg. of radium filtered so as to provide gamma radiation. After trial of different dosages, 50 milligram hours (2½ gram minutes) became their routine dosage. This requires an hour of application to each side.

Fowler Jr.[14] used 25 mg. of radium filtered for gamma radiation and left the applicator in each side for one hour and twenty minutes to get the 2 gram minute dosage.

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12. Fisher, G. E.: Recognition and Radium Treatment of Infected and Hypertrophied Lymphoid Tissue in the Nasopharynx, Arch. Otolaryng. **37:** 434-436 (March) 1943. Jones, E. H.: Irradiation of the Nasopharynx in Office Practice, ibid. **37:**436-438 (March) 1943.

13. Farrior, J. B., and Richardson, G. A.: Nasopharyngeal Applicator, Arch. Otolaryng. **35:**811-812 (May) 1942.

14. Fowler, E. P., Jr.: Non-Surgical Treatment of Deafness, Laryngoscope **52:**204-217 (March) 1942.

Emerson Jr., Dowdy and Heatly [15] employed 25 mg. of radium filtered so as to yield the more caustic beta rays as well as the gamma rays. A twelve minute exposure to the side provides 300 milligram minutes (0.33 gram minutes).

Within the past year, a 50 mg. radium applicator filtered to provide both beta and gamma radiation has been constructed of Monel metal by the Radium Chemical Company of New York. This is used to give 330 milligram minutes of radiation to each side. The time of application is six minutes and thirty-six seconds to each side. Crowe [10] stated in 1944 that the applicator had been used in the Hagerstown Clinic for the Prevention of Deafness in Children and that the results in 259 patients had been as good as those obtained with radon.

Comparison of Nasal Tubes

Depth in Tissue, Mm.	Platinum Wall, 0.5 mm. Brass Wall, 0.4 mm. Gamma Ray Roentgens Platinum Tube *	2,000 mc. min. 300 mc. min. Gamma Ray Roentgens Brass Tube	Beta Ray Roentgens Brass Tube †	Total Dose of Roentgens Brass Tube
0	4,700	790	13,310	14,100
1	2,500	405	4,095	4,500
2	1,460	230	1,415	1,645
2.25	1,300	200	1,100	1,300
3	960	156	534	690
4	680	110	226	336
5	480	84	100	184

Percentage Depth Dose

Depth, Mm.	Platinum	Brass
0	100.0	100.0
1	53.2	31.9
2	31.0	11.7
3	20.4	4.9
4	14.5	2.4
5	10.4	1.3

* The number gamma ray roentgens was calculated from the Sievert formula.
† The number of beta ray roentgens was determined by comparison in water phantom by photographic methods.

In July of 1943 I first used radon filtered so as to give the more caustic beta rays. Three hundred millicurie minutes (0.33 gram minute) was used, and at the same time 2,000 millicurie minutes (2 gram minutes) of gamma radiation was used on the opposite side. Clinically, no difference in effect was noted. The physicist at the University Hospitals compared the two tubes for me and provided the figures in the accompanying table.

The table shows that the total number of roentgens received by the lymphoid tissue is the same at a depth of 2.25 mm. whether one is employing 2 gram minutes of gamma radiation or 0.33 gram minute of beta and gamma radiation. At a greater depth, such as 5 mm., the

15 Emerson, E. B., Jr.; Dowdy, A. H., and Heatly, C. A.: Use of Radium in Treatment of Deafness by Irradiation, Arch. Otolaryng. **35**:845-852 (June) 1942.

roentgen dose is about 2.6 times greater with the gamma radiation than it is with the combined beta and gamma radiation, but the dose of either is very small at this depth.

The new monel metal applicator now on the market has a beta and gamma effect slightly higher than that of the nasal tube with brass filtration referred to in the table.

PERSONAL OBSERVATIONS

My observations on the clinical effectiveness of irradiating nasopharyngeal lymphoid tissue with radon or radium are drawn from the results obtained in a small series of private patients whom I studied over considerable periods. I first tried methods of treatment other than irradiation and had the opportunity to make repeated personal observations. A larger group has been observed in the outpatient clinic at the University Hospitals, in which the diagnosis and the treatment were carried out mostly by the resident staff. The results in the latter group approximate those in my personal series.

The personal series numbers 73 patients. I have divided them into 5 groups:

1. The first group contains a majority of the patients—54. All had hearing impairments which were obvious to the parents and when tested presented a generalized depression of the hearing threshold through the speech frequencies and the high notes. All had had tonsils and adenoids removed and presented a variable amount of nasopharyngeal lymphoid tissue. When this amount was of any appreciable size, surgical removal was performed as the first step in the treatment of the hearing loss. All showed some abnormal changes of the tympanic membrane usually in the form of retraction, loss of luster, and in some the waxy pink appearance one often sees when thick mucus is present in the middle ear, or the hair line or bubbles of fluid. In all an attempt was first made to relieve the condition by some of the usual measures, such as instilling nose drops to produce vasoconstriction, using mild protein silver–glycerin packs in some patients with associated rhinitis and sinusitis, and displacement therapy. Furthermore, treatment was not immediately instituted in any case, but a minimum interval of a month elapsed between the date of the onset of the hearing loss and the irradiation.

Normal hearing was recovered in 46 of these patients; 8 did not recover normal hearing after irradiation.

The following 2 case studies are illustrative:

A. G., aged 6½, was first examined in February and March of 1942. No treatment was carried out. Another examination was made in July, when the hearing was practically normal. Approximately a year later, the mother brought the child back because she had detected some hearing impairment. The child had acute rhinitis and pharyngitis. The findings in the nose were not definitely

indicative but were suggestive of hay fever. The hearing in each ear was depressed to the 20 decibel level through the speech frequencies (see record of Aug. 27, 1943). Treatment was postponed pending the advent of frost because of the suspicion of hay fever. On Oct. 22, 1943 the hearing was still further impaired. Three hundred millicurie minutes (0.33 gram minute) of radon filtered so as to yield largely the beta rays was given to each side on October 23 and again on November 20. The hearing was normal in practically all frequencies on Jan. 8, 1944. A recheck approximately eight months later indicated that the improvement had been sustained.

J. C., aged 14, was first examined in June of 1943. He was having frequent head colds. His left ear felt blocked. A slight depression of hearing was detected

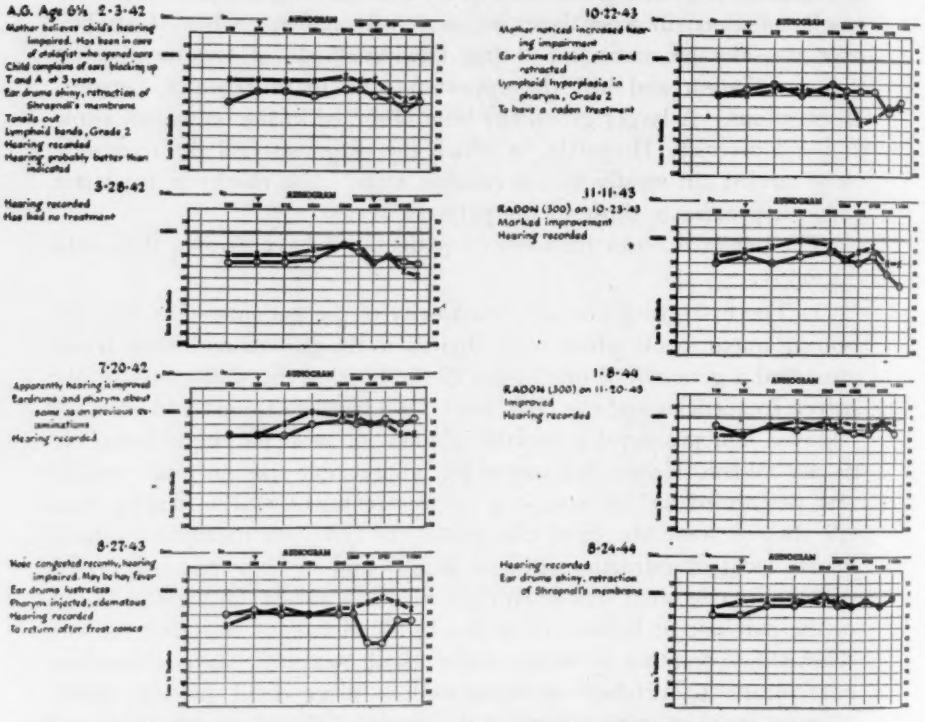

Chart 1.—Audiograms of patient A. G., aged 6½ who had a loss in hearing for speech frequencies and whose hearing improvement was found still maintained eight months after irradiation of nasopharyngeal lymphoid tissue. *T and A,* tonsillectomy and adenoidectomy.

in the left ear through almost all of the tonal frequencies. Vasoconstriction and Politzer inflation brought relief.

In August he experienced a bilateral hearing loss (see audiogram of Aug. 27, 1943) as the sequela of a head cold on his return from a boys' camp. Vasoconstriction and inflation during the next month were followed by some improvement but not a return to normal. The nasopharyngoscopic examination revealed a small amount of lymphoid tissue in Rosenmüller's fossa on each side and an edematous appearance of each tubal orifice. Treatment with 300 millicurie minutes of radon (0.33 gram minute) filtered so as to provide chiefly the beta rays was given

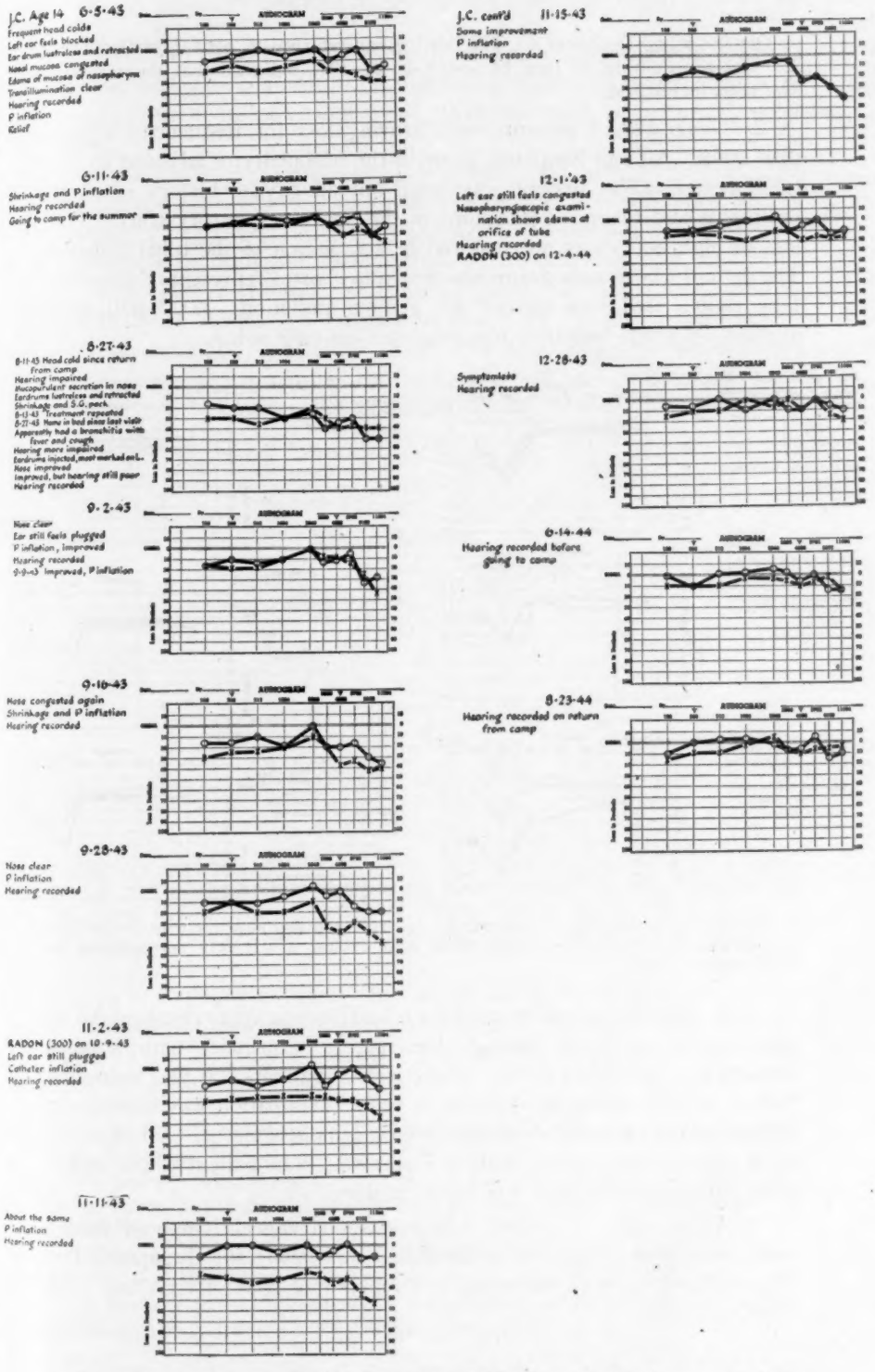

Chart 2.—Audiograms of patient J. C., aged 14, whose hearing improvement was found maintained approximately nine months after irradiation therapy. *P*, Politzer inflation; *S.G.*, mild protein silver-glycerin.

on October 9 and December 4. The hearing had returned to normal on December 28. Subsequent tests on June 14 and Aug. 23, 1944 indicated that the recovery had been maintained.

2. There were 4 patients with hearing loss for frequencies higher than 2048. All had lymphoid tissue in the nasopharynx adjacent to the tubal orifice. The amount was small but all gave a history of aural symptoms and recurrent infections of the upper respiratory tract. The loss of high notes was not restored by irradiation of the tubal orifices. The patient whose audiograms are shown in chart 3 represents this group (the radon used was filtered for gamma radiation; 2,000 millicurie minutes—2 gram minutes—was employed on each side).

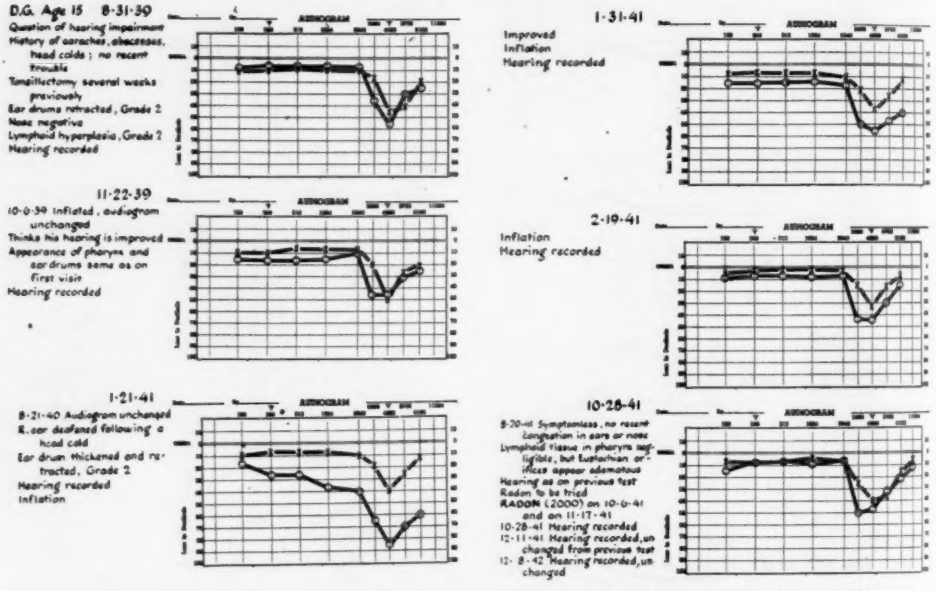

Chart 3.—Audiograms of patient D. G., representing patients who had a loss in hearing for frequencies higher than 2048 cycles, which was not reduced by irradiation therapy.

3. Another group was treated for a hearing loss approximating the 30 decibel level or lower through the speech frequencies with a more marked loss for higher notes. There were 7 patients. It was suspected that a cochlear lesion was present in each. Irradiation was carried out because of the presence of nasopharyngeal lymphoid tissue. No improvement was obtained in any of these 7 patients. The patient whose audiograms are shown in chart 4 is representative.

4. There were 5 patients whose nasopharyngeal lymphoid tissues were irradiated because of a slight loss of hearing for the speech frequencies and for high notes and a complaint of nasal obstruction. All were relieved.

5. Three patients with mucoid material discharging through a chronic perforation of the drum membrane received irradiation of some lymphoid tissue in the nasopharynx. The treatment was of questionable value.

It has occurred to me that there are probably several factors which might determine whether a patient will or will not suffer any loss of hearing from obstruction of the eustachian tube and whether irradiation might be responsible for changing the picture and restoring the normal hearing. The distribution of lymphoid tissue within the tube could be one of these factors. A number of observers (Wolff [16]; Semenov [17]; Polvogt and Babb [18]; Decker [19] have after microscopic studies reported lymphoid nodules in various locations within the tube, most often within the pharyngeal portion, but occasionally such nodules are seen in the

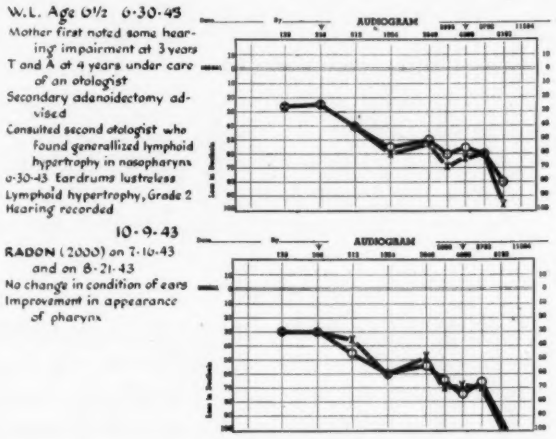
W.L. Age 6½ 6-30-43
Mother first noted some hearing impairment at 3 years
T and A at 4 years under care of an otologist
Secondary adenoidectomy advised
Consulted second otologist who found generallized lymphoid hypertrophy in nasopharynx
6-30-43 Ear drums lustreless
Lymphoid hypertrophy, Grade 2
Hearing recorded
AUDIOGRAM
10-9-43
RADON (2000) on 7-10-43 and on 8-21-43
No change in condition of ears
Improvement in appearance of pharynx
AUDIOGRAM

Chart 4.—Audiograms of patient W. L., representing patients who had a loss of 30 decibels or more through the speech frequencies and a marked loss for higher frequencies. Irradiation of nasopharyngeal lymphoid tissue produced no improvement in the hearing of these patients. *T and A,* tonsillectomy and adenoidectomy.

mucosa of the bony portion. One of the factors of the tubal obstruction is undoubtedly also the amount of edema of the loose folds of tubal lining in the pharyngeal portion. The tunica propria at this site lends itself to edematous change.

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16. Wolff, D.: Microscopic Observations of the Eustachian Tube, Ann. Otol., Rhin. & Laryng. **40**:1055-1069 (Dec.) 1931.

17. Semenov, H.: Some Observations on the Histopathology of Inflammation in the Eustachian Tube and Middle Ear, Tr. Am. Laryng., Rhin. & Otol Soc. **42**:563-598, 1936.

18. Polvogt, L. M., and Babb, D. C.: Histologic Studies of the Eustachian Tube of Individuals with Good Hearing, Laryngoscope **50**:671-675 (July) 1940.

19. Decker, R. M.: Relation of Eustachian Tube to Chronic Progressive Deafness, Arch. Otolaryng. **36**:926-936 (Dec.) 1942.

Such factors as the size of the tube and the total air capacity undoubtedly play a role. If the air capacity of the middle ear and mastoid is small, one might reasonably expect a more severe acute reaction to tubal obstruction in the matter of the development of negative pressure within the middle ear.

An allergic factor in edema of the soft tissue must not be overlooked when one considers tubal obstruction.

I have concluded that the tendency toward obstruction of the eustachian tube is not in proportion to the amount of hyperplastic lymphoid tissue present. Crowe has stated that "it is not the size but the location of the lymphoid nodules that is important."

It has been my observation that in children lymphoid nodules in Rosenmüller's fossa do not disappear completely after irradiation with as many as three exposures.

The possible role of hyperplastic lymphoid tissue in blockage of the eustachian tube has a new interest through observations of air corpsmen in whom the condition called aero-otitis media or, as the British call it, acute otitic barotrauma developed. Fowler Jr.[20] has recently reported a study of airmen in England. He expressed the belief that it is important to control the hyperplastic tissue in the nasopharynx by irradiation as a means of lessening the incidence and the complications of otitic barotrauma.

SUMMARY

Hyperplasia of the pharyngeal lymphoid tissue of children is very common. This tissue seems to play an important role in the hearing impairment resulting from the effects of edema in the eustachian tube. The tendency toward involvement of the ear from infection of the lymphoid tissue is not in direct proportion to the amount of this tissue present in the nasopharynx but apparently depends on its distribution and the susceptibility of the patient to infection.

Small doses of radium or radon filtered so as to yield chiefly the beta rays seem effective in controlling the pathologic effect of small amounts of this tissue in its relation to the normal function of the eustachian tube. The dose is so small that no local reaction is observed or experienced in the form of hyperemia, irritation or other untoward effect. Crowe regards this action as a "biological" one in which mitosis of the lymphocyte is inhibited.

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20. Fowler, E. P., Jr.: Radon Treatment for Otitis Due to Barotrauma, J. Laryng. & Otol. **58**:489-492 (Dec.) 1943.

PLASTIC REPAIR OF THE DEFLECTED NASAL SEPTUM

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THE PURPOSE of this paper is to challenge contemporary orthodoxy [1] which still adheres to the concept that maintenance of the profile projection of the nasal pyramid is dependent mainly on support furnished by the septum. Probably this concept has never been seriously questioned because of the saddling of the dorsum and the drooping of the tip following a too generous submucous resection. The fear of such unfortunate consequences has led surgeons to leave an "ample" ventral (anterior) and caudal (inferior) buttress in the management of septal deflections, even when these parts of the septum were in themselves major factors in the obstruction.

If "the stream of inspired air," as expressed by Proetz,[2] "does not pursue a straight course from nostril to choana, but passes, in the main, in a wide curve beginning at the nostril, extending through the olfactory fissure and ending in the choana," (fig. 1)—a fact which can be demonstrated by the interference with breathing occasioned when one pinches the nose just above the lobule (fig. 2)—then the orthodox submucous resection must necessarily be but a relatively successful procedure, capable of correcting only dorsal (posterior) deflections. Deformities occurring in the most ventral and caudal areas of the septum, equally important from the standpoint of obstruction and certainly as common, must be left in their faulty positions lest saddling of the dorsum and collapse of the tip ensue.

We will offer anatomic, mechanical and clinical evidence which suggests that the prevailing concept needs revision. We will attempt

1. Salinger, S.: Deviation of Septum in Relation to Twisted Nose, Arch. Otolaryng. **29**:520 (March) 1939. Metzenbaum, M.: Replacement of Lower End of Dislocated Septal Cartilage Versus Submucous Resection of Dislocated End of Septal Cartilage, ibid. **9**:282 (March) 1929.

2. Proetz, A.: Applied Physiology of the Nose, St. Louis, Annals Publishing Company, 1941, p. 114.

to show (1) that under static conditions the septum is merely a redundant member, offering no support whatever; that it functions only as a reserve safety factor when external crushing forces or internal tension stresses disturb or distort its equilibrium, for the same reason that reserve safety factors in the form of trusses are added to a gabled roof in order that it may withstand the adventitious forces of nature, such as storms, cyclones and snow, and (2) that the saddling of the nose following a submucous septal resection too near the dorsum and the drooping of the tip, the distortion of the lobule and the

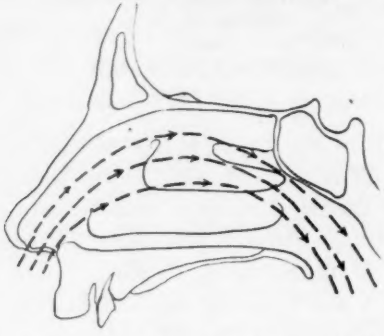

Fig. 1.—Inspiratory air currents in nose (Proetz: "Applied Physiology of the Nose"[2]).

Fig. 2.—Pinching of nose just above the lobule to demonstrate interference with respiration.

asymmetry of the nares following the removal of the caudal end of the septum are not the results of lack of septal support but are due to the development of internal stresses arising from cicatrization of the deskeletonized connective tissue, for the same reason that the pull of scar tissue in the region of the eyelid may cause ectropion. Excision of all contracted scar tissue from the lid will immediately relieve the deformity by allowing the surrounding structures to assume their normal relationships. To prevent recurrence, however, the part from which

the scar tissue was excised must be resurfaced. So, likewise, a distorted lobule, produced by the dislocated caudal end of the septum, immediately springs back into its normal position as soon as it is released from the displaced septum (unless there is adventitious pathologic change), and here, also, recurrence is guarded against by the prevention of subsequent traction forces.

Our clinical experience has sustained this hypothesis, i. e., that any part of the septum, including the ventral or the caudal buttress or both, can be resected if provision is made to prevent the action of the subsequent tension forces brought about by cicatricial contraction.

We shall divide the septum arbitrarily, into an anterior and a posterior part by an imaginary line extending from the nasal spine of the frontal bone to the nasal spine of the maxillas (fig. 3). Inasmuch

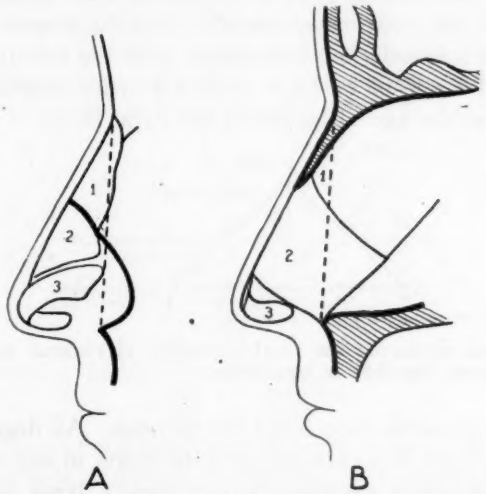

Fig. 3.—Septum divided into ventral and dorsal compartments by an imaginary line from the nasal spine of the frontal bone to the nasal spine of the maxillas. *A*, ectal view. *B*, ental view. *1* indicates the osseous vault; *2*, the upper cartilaginous vault, and *3*, the lower cartilaginous vault.

as submucous resection in the posterior (dorsal) part of the septum is not under controversy, we shall limit ourselves to the part anterior to the divisional line, which we shall subdivide as follows: (1) the septum of the osseous vault, (2) the septum of the upper cartilaginous vault and (3) the septum of the lower cartilaginous vault (fig. 3).

THE SEPTUM OF THE OSSEOUS VAULT

Anatomic Considerations.—If the nasal cavity is likened to a mezzanine floor between the oral and cranial cavities, the osseous vault may be compared with a balcony in the form of a pyramid projecting beyond it. The apex of the pyramid dovetails into the nasal process

of the frontal bone like the halving joint used in carpentry and is further strengthened beneath by the underpinning of the nasal spine of the frontal bone. The gable, formed by the juxtaposition of the two nasal crests, is a solid block of bone above, gradually thinning out below. The walls of the pyramid comprise the nasal bones and the flaring frontal processes of the maxillas, firmly supported on maxillary abutments, which are themselves reenforced by flying buttresses—the maxillary sinuses.

The septum of the osseous vault is composed of the crest of the nasal bone, the nasal spine of the frontal bone, septal cartilage and the perpendicular plate of the ethmoid. The perpendicular plate (mesethmoid), according to Schaeffer,[3] represents the ossified upper portion of the primitive cartilaginous nasal capsule. Ventrally it articulates with the nasal spine of the frontal bone, the crests of the nasal bones and the septal cartilage, caudally with the vomer, dorsally, with the crest of the sphenoid and cephalically with the cribriform plate.

The ventral extension of the mesethmoid varies considerably. It may extend as far as the caudal border of the nasal bones or may terminate

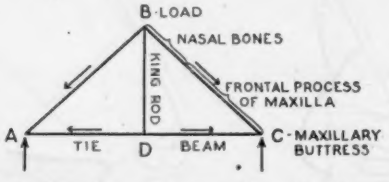

Fig. 4.—Truss simulating the nasal pyramid. Horizontal and vertical forces balance out and are therefore in equilibrium.

at the level of the nasal spine of the frontal bone. All degrees of development between these two extremes may be found in any series of skulls. Obviously, the septal cartilage is reciprocally large or small in the structural formation of the nasal septum.

Mechanical Considerations.—According to a law of mechanics which goes back to Newton, a body is in equilibrium if the sum of all horizontal and vertical forces balances out. This principle may be employed to prove that the septum under static conditions is a redundant member, furnishing no support whatsoever, and that it becomes a factor of support only when a "live load," in the form of crushing forces from without or traction forces from within, is applied.

The nasal pyramid may be considered a truss (fig. 4). Its lateral walls (nasal bones and frontal processes of the maxillas) are struts or rigid arches, resting on maxillary abutments. By simple algebraic summation one can easily prove that all the horizontal and vertical forces

3. Schaeffer, J. P.: The Nose, Paranasal Sinuses, Nasolacrimal Passageways and Olfactory Organ in Man, Philadelphia, P. Blakiston's Son & Co., 1919.

balance out and therefore are in equilibrium, being able to maintain their position and contour without the aid of the septum.

In architecture, when the span exceeds a given distance, a center rod is added for support, as shown by the line *BD* in figure 4. This is called the king rod truss. In the same manner the septum acts as a reserve to prevent collapse of the pyramid when extraordinary crushing forces from without or tension stresses from within are applied.

The truss *ABCD* (fig. 4) is supported at *A* and *C* and has a load applied at *B*. If we consider the truss connected by pins (actually these may be riveted joints) for purposes of analysis and take out the point *B* as a free body, we may show *B* as in figure 5*a*. Obviously, *AB* acts up to the right and *BC* up to the left, as shown. The horizontal forces acting on *AB* and *BC* must balance out, as they are the only forces having horizontal components. The force of the load going down vertically must equal (algebraically) the sum of the vertical components in *AB* and *BC* and the force in *BD*, if there is a force in *BD*. From figure 5*a* we cannot determine definitely if *BD* carries any force. In order to do this we go to another joint, *D*, which has but three members and thus offers a better chance for a solution. By taking joint *D* out, as in figure 5*b*, we may start our analysis. *AD* and *DC* must be tension members, acting as shown, because *A* and

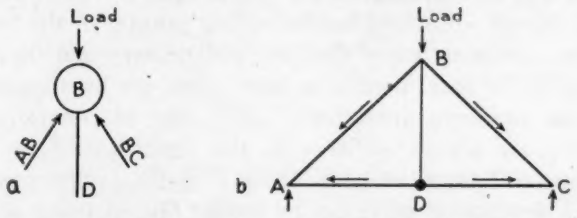

Fig. 5.—Diagrams to illustrate that under static conditions the septum furnishes no support.

C tend to spread apart when a load is applied downward at *B*. Since *AD* and *DC* are horizontal and have no vertical components they contribute no vertical push to *D*, and since there is no other vertical force at *D* then the force in *BD* would equal *L* and would be in tension. If a load *L* is applied upward at *D*, then *BD* is in compression and has a force of *L* (fig. 5).

Clinical Considerations.—It is conceded that removal of the mesethmoid will not alter the external architecture of the osseous vault. The stresses, no matter how extensive, brought about by the cicatricial contraction in the mucoperiosteal membranes, are incapable of overcoming the sturdy construction of this arch.

THE SEPTUM OF THE UPPER CARTILAGINOUS VAULT

Anatomic Considerations.—The upper cartilaginous vault is composed of a roughly quadrilateral piece of cartilage, which enters into the formation of the septum, and two triangular, winglike extensions, that form the middle cartilaginous vault and give stability to the middle third of the nose. According to Schaeffer, it is developed from the

cartilaginous nasal capsule and constitutes one piece (cartilago mediana nasi). There is no morphologic or embryologic reason to consider these elements as separate entities.

Owing to its cartilaginous nature, the upper cartilaginous vault furnishes the necessary rigidity and elasticity to maintain an adequate total capacity and yet permit variations in shape for respiration and expression. It also acts as a buffer to diffuse forces applied to the nose, thus protecting the structures in the anterior cranial fossa against concussional force.

The wings of the septal cartilage (upper lateral cartilages) function similarly to a tracheal ring to maintain an air channel under varying pressures. Caudad, their relation to the septal cartilage is valvelike, to regulate the size and velocity of the air current. For example, on forced inspiration the negative pressure brings the wings closer to the septal cartilage, diminishing the inlet so that the air is introduced in thinner laminas, thereby preventing too rapid an evaporation of secretions and chilling of the membrane.

The upper lateral cartilages are triangular plates located in the middle part of the lateral surface of the projecting portion of the nose. They vary in size. In some cases they are rudimentary and do not extend the breadth of the nasal bones; in others they are broad and reach far down on the pyriform aperature. They may be convex or concave and together are almost as large as the septal cartilage. Cephalad, they are attached for a variable distance to the under surface of the nasal bones and frontal processes by strong fibrous tissue aponeuroses. They usually extend to the agger nasi but may reach the base of the nasal spine. Their attachment to the bone is strong, and great force is required to tear them away. Below, they underride the lower lateral cartilages. Their ventral borders are thick above, continuous with the cartilage of the septum and wedged between the nasal bones for a varying distance. They may diverge from the septal cartilage, leaving a fissure on each side, the interval being filled in with sesamoid cartilages and covered over by the overlap of the lower lateral cartilages. The dorsal borders are thin and attached to the maxillas and to the nasal bones.

According to Schaeffer, the septal cartilage represents the ventral extremity of the primordial cartilaginous cranium. It is irregularly quadrilateral in shape and approximately 1.5 mm. thick. Its dorsocephalic border is attached to the perpendicular plate of the ethmoid; its dorsocaudal border is attached to the vomer and maxilla as far as the anterior nasal spine; its ventrocephalic border is fixed along the internasal suture above, and laterally it becomes confluent with the upper lateral cartilages, the latter extending winglike from it. Caudally, it extends between the lower lateral cartilages to within ½ inch (1 cm.)

of the tip of the nose. Dorsally, the septal cartilage extends variably between the vomer and the perpendicular lamina of the ethmoid, thus forming the sphenoidal process of the septal cartilage.

Mechanical Considerations.—The anatomic attachment of the upper cartilaginous gable to the under surface of the nasal bones and frontal processes of the maxillas is such as to furnish sufficient stability to maintain its profile projection under static conditions. The septum, here as in the osseous vault, acts as a reserve safety factor to combat extraordinary crushing forces from without or tension stresses from within; however, as the upper cartilaginous vault lacks the sturdy construction of the osseous vault, lesser forces are required to alter its architecture.

The anatomic relationship of the osseous and cartilaginous gables is based on the cantilever principle, that is, the further the cartilaginous gable extends beneath the distal edge of the osseous gable the greater is its achieved stability under stress. In accordance with a principle of engineering, if one gable is slipped beneath another and is to maintain

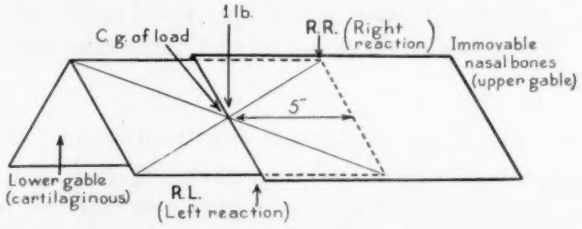

Fig. 6.—Cantilever principle, illustrating the relationship of the middle cartilaginous vault to the upper osseous vault.

its position, the underlying gable must be slid beyond a point marking the corresponding center of gravity of each of its sides. Obviously, if this center of gravity lies in front of the lower border of the upper gable, then the lower gable will fall out of place. If the center of gravity (*C. g.*, fig. 6) is exactly coincident with the lower border of the uppermost gable, the lower gable, although maintaining a position of equilibrium, will be immediately subject to displacement by the slightest extraneous force.[4]

In order to illustrate the problem from an architectural standpoint, assumed loads and lengths will be used.

Take moments about *RR* (fig. 6). If *RR* is assumed to be hinged, what force must be applied at *RL* to support a load of 1 pound (0.5 Kg.)?

$$1 \text{ pound} \times 5'' = RL \times 5'' \qquad \frac{1 \times 5''}{5} = RL \qquad RL = 1 \text{ pound.}$$

4. Poorman, A. P.: Applied Mechanics, ed. 4, New York, McGraw-Hill Book Company, Inc., 1940, sect. 20-22. Chambers, S. D., and Faires, V. M.: Analytic Mechanics, New York, The Macmillan Company, 1943, section. 16-18.

From this we conclude that a load directly over a reaction will be supported directly by that reaction. In this condition the load is balanced on the reaction. A slight disturbance one way or another will rotate the load on the reaction point. Similar propositions based on the relation between the upper and lower gables can be solved in like manner.

Clinical Considerations.—That the upper lateral cartilages will maintain the profile projection of the nose without the aid of the septum is an undeniable clinical fact, which we have demonstrated hundreds of times in the course of rhinoplastic operations. It is to be particularly noted that the saddling which occurs after an extensive septal resection in this location occurs almost invariably not at the time of operation but some weeks later. If the septum were the supporting element, the saddling should occur immediately. The fact that it occurs at a later time bears out our contention that the deformity is not due to lack of support but rather to tension forces arising from cicatricial contraction. In the rare instances when saddling does occur at the time of operation, it is due to the swinging away of the upper lateral cartilages from the septum at an unusually high level (cephalad), together with insufficiently developed lower lateral cartilages which are unable to bridge the intervening space. Only in such cases does the septum act as a support.

THE SEPTUM OF THE LOWER CARTILAGINOUS VAULT

Anatomic Considerations.—The lower lateral cartilages, horseshoe shaped and about 1 mm. in thickness, partly encircle the ventral part of the nares and assist in keeping the nares and the vestibule open. They control the shape and the direction of the current and are active in expression and phonation. They overlap the upper lateral cartilages, to which they are attached by an aponeurosis. Through this relationship they regulate the velocity of the current, acting as check ligaments to prevent too close an approximation of the upper lateral cartilages to the septum.

The lateral crus averages 13 mm. in its broadest dimension and 7 mm. at its free end. It is attached dorsally to the maxilla by a strong sheet of fibrous tissue in which are embedded the lesser alar cartilages. Ventrally, the lateral crus becomes confluent with the angle. Cephalad, it is bound to the upper lateral cartilage by a fibrous membrane and to the caudoventral part of the cartilaginous septum. Caudad, it just falls short of the margin of the nares.

The mesial crus is narrow and lies in the columella caudad to the cartilage of the septum, to which it is attached by a membranous aponeurosis. Ventrally, it abuts its fellow on the opposite side and ends dorsally in two out-turned extremities. It lies at a lower level than the lateral crus and can thus be seen throughout its extent in profile.

Mechanical Considerations.—Structurally, the lower lateral cartilages are comparable to:

1. A double-arched bridge, with the footing of each pier hinged on its foundation so as to permit rocking. The advantages of this construction are that the bridge can be built more economically and more slenderly and that any bending stresses developed in it have full play because of the hinge, i. e., the pier yields or bends without breaking, because it rocks. Figure 7 is self explanatory. The cartilage angles, then, are the "arches," while the lateral crura and the alar pad of connective tissue are the "piers." The bony margin of the pyriform opening of the maxilla is the "foundation." The "footings" are made up of thick and stiff connective tissue hinged by crossed fibroelastic fibers attached to the periosteum astride the thin edge of the maxillary process

2. A cantilever bridge, such as the Forth bridge (fig. 8). ". . . each pier carries . . . its own double-armed cantilever, linked by a short connecting

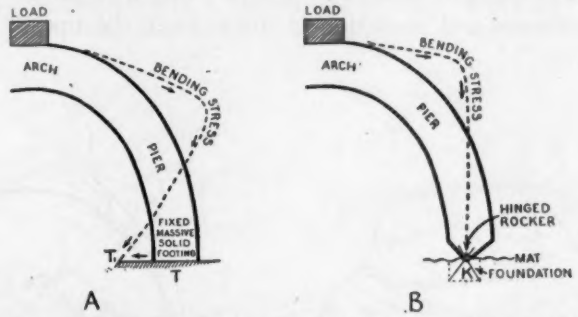

Fig. 7.—*A*, double-arched bridge with fixed footing. A load tends to spread the knee of the arch. The footing T_1 will tend to be displaced to T, under the bridge. *B*, footing hinged at *K*, the knee spreading only while footing rocks at *K*.

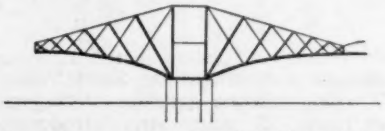

Fig. 8.—A two-armed cantilever of the Forth bridge (Sir D'Arcy Thompson [5]).

girder to the next, but so jointed to it that no weight is transmitted from one cantilever to another. The bridge in short is 'cut' into separate sections, practically independent of one another; at the joints a certain amount of bending is not precluded, but shearing strain is evaded; and each pier carries only its own load . . . the whole system forms a continuous structure. . . . These two cantilevers are not independent, but are bound up in one common field of force.[5]"

Clinical Considerations.—The lower cartilaginous vault is even less dependent for support on the septal cartilage than are the upper and middle vaults. In proof we offer these clinical observations:

1. In the typical rhinoplasty, to expose the nasal skeleton an incision is made between the upper and lower lateral cartilages on both sides.

5. Thompson, D. W.: On Growth and Form, New York, The Macmillan Company, 1942, p. 992.

A button-end knife is carried from one incision to the other, and the membranous septum is cut through. Thus, the lower lateral cartilaginous vault is completely separated from the upper cartilaginous vault. Despite this, the lobule maintains its original position and contour. As a matter of fact, if the lobule were originally distorted by cicatricial pull arising from a septal dislocation, it will jump back into its normal position after the transfixion unless there is adventitious pathologic change within the cartilages.

2. In the case of a long nose, the removal of a triangle from the septal cartilage for the purpose of shortening has no effect on the position of the lobule, even though a space remains between the middle and lower vaults.

3. Further proof is offered by the fact that in a saddle nose, with multiple fractures and impaction of the septum, the tip still maintains its projection.

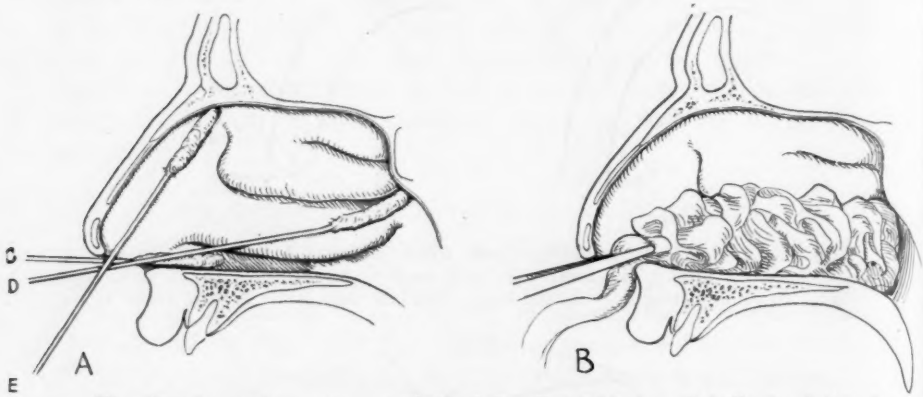

Fig. 9.—*A*, nasal mucosa anesthetized by direct block. *E* indicates internal nasal nerve block; *D*, sphenopalatine ganglion block, and *C*, nasopalatine and anterior palatine nerve block. *B*, gauze strip introduced to prevent escape of blood into the nasopharynx.

MANAGEMENT

The following procedure we have gradually evolved, based on the concept described.

Preoperative Management.—One hour before operation the patient is given two capsules (3 grains [0.19 Gm.]) of pentobarbital sodium. The vibrissae are clipped, and the vestibules are scrubbed with medicinal soft soap on cotton-tipped applicators and then swabbed with alcohol and ether. Three cotton-tipped applicators are dipped in a solution of equal parts of 10 per cent cocaine and 1 : 1,000 epinephrine, squeezed dry of excess fluid and inserted as follows (fig. 9 *A*): (*E*) one beneath the dorsum along the olfactory sulcus (internal nasal nerve block), (*D*) one at the foot of the middle concha (sphenopalatine ganglion

block) and (*C*) one along the floor of the nose (nasopalatine and anterior palatine nerve block). One or 2 drops of sterile castor oil is instilled into each eye. In twenty minutes the nasal applicators are withdrawn, and the face and vestibules are scrubbed with medicinal soft soap and water for three minutes. The face is then swabbed with alcohol, followed by ether. The patient is draped, and the nasal fossae are packed with long strips of ½ inch (1.2 cm.) gauze, the vestibules being left clear (fig. 9 *B*).

TECHNIC

The membranous septum on the right side is incised throughout its extent with a no. 15 Bard-Parker knife, perforation through the opposite side being guarded against by the index finger held in the left vestibule (fig. 10*A*). A bed is created in the columella by separation of the two laminas with a no. 15 Bard-Parker knife supplemented by a Stevens scissors (fig. 10*B*). The two layers are held apart with dural hooks, and a cartilage graft is introduced and fixed in

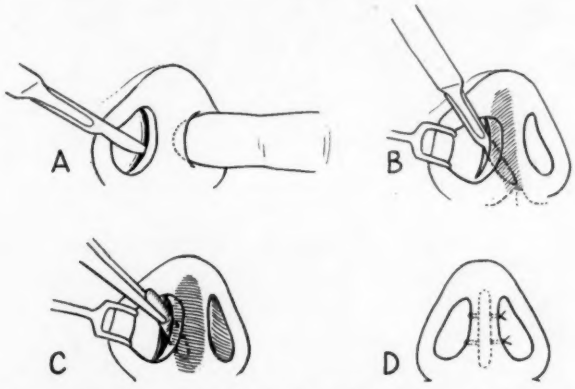

Fig. 10.—*A*, membranous septum incised, the index finger protecting the opposite wall against perforation. *B*, bed prepared in the columella for reception of graft. *C*, insertion of the columellar graft into prepared pocket. *D*, graft held in place by sutures passed behind it.

place by one or two through and through silk mattress sutures passed behind the graft (fig. 10*C* and *D*). The width and thickness of the graft will vary from 2 to 4 mm., depending on the amount of contraction anticipated. Its length will average 2.5 to 3 cm., depending on the projection of the tip.

It is to be emphasized that this cartilage graft is not introduced as a support, since it has no abutment to the lower lateral cartilages ventrally or to the nasal spine of the maxillas dorsally. Its purpose is merely to act as a batten to prevent retraction of the columella, occasioned by the subsequent inevitable pull of contracting connective tissue in the septal flaps.

When the cartilage graft has been fixed in place, the left ala is elevated with a rake retractor. The aponeurosis between the upper and lower lateral cartilages is incised with a Bard-Parker no. 11 knife, the incision beginning at the center of the plica and extending ventrally to the septum (fig. 11). A similar incision is made on the opposite side.

A button-end knife is introduced through the left vestibular incision and swept obliquely downward across the dorsum until its tip appears through the vestibular incision on the right side (fig. 12). The knife is carried down to the caudal end of the septum and turned at right angles, and, with the blade hugging the caudal

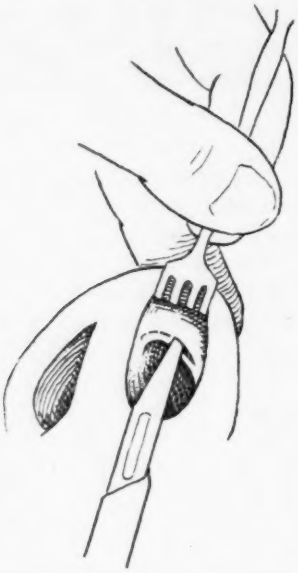

Fig. 11.—Plica nasi exposed and aponeurosis connecting upper and lower lateral cartilages incised with a Bard-Parker no. 11 knife.

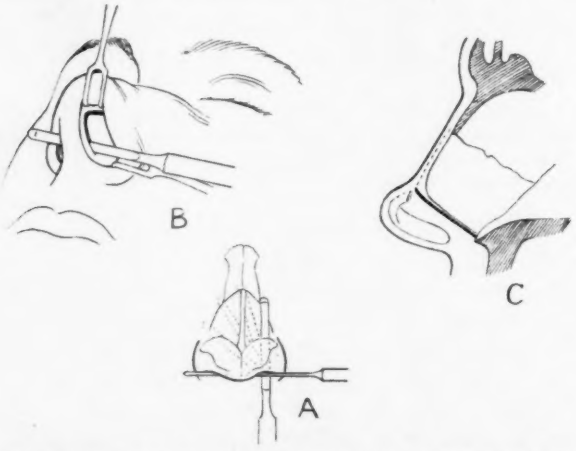

Fig. 12.—Caudal exposure of the nasal pyramid. *A* indicates button-end knife introduced, advanced to nasofrontal suture and swept obliquely downward until the tip appears through the opposite intercartilaginous incision. *B* indicates membranous septum cut through. *C* indicates line of separation.

margin of the septal cartilage, transection of the membranous septum is completed. With a straight Mayo scissors held perpendicular to the nasal spine, the mem-

branous septum is straddled, and with one snip of the scissors it is completely divided down to the nasal spine (fig. 13).

By the retraction of the lower cartilaginous vault to one or the other side, the septum is brought into clear view. With a Bard-Parker no. 11 knife a thin sliver is removed from its caudal margin in order to furnish a clearer delineation of the line of cleavage (fig. 14*A*). A curved needle armed with heavy silk is passed through the caudal margin of the mucoperichondrium on the left side. The suture ends are grasped with a hemostat, which is thrown over the side of the face to act as an automatic retractor. A similar suture is passed through the mucoperichondrium on the other side (fig 14*B*). Elevation of the membrane is accomplished in the usual manner, the extent depending on the deformity.

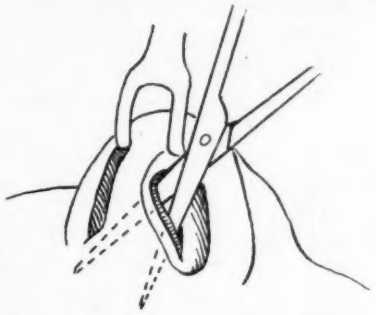

Fig. 13.—Completion of caudal exposure. The membranous septum is straddled by a Mayo scissors, and the structures are divided to the nasal spine.

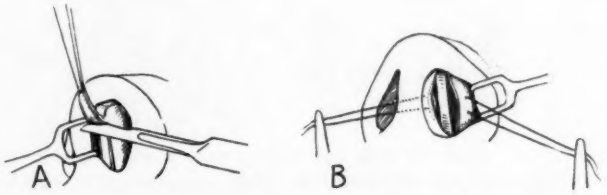

Fig. 14.—*A*, sliver resected from the caudal edge of the septum to delineate the line of cleavage. *B*, sutures through the mucoperichondrium, serving as automatic retractors.

The obstructing cartilage, irrespective of its location, is removed with a scissors or swivel knife as far ventrad or caudad as is necessary (fig. 15*A*). Inasmuch as the septum is a redundant member under static conditions, one need not fear immediate saddling of the dorsum or drooping of the tip from too ventral or too caudal a resection, provided measures are taken to prevent subsequent contractile deformities. This is accomplished by the reinsertion of cartilage, the choice of material depending on conditions present. If the resected cartilage is usable or can be made usable by shaving or cross hatching, it is preferable. Otherwise, isografts of septal cartilage preserved in merthiolate solution [6] are employed.

While the cartilage is held with a rat tooth forceps by the assistant, the two flaps of mucoperichondrium are brought to the midline on each side of the

6. Fomon, S.: Surgery of Injury and Plastic Repair, Baltimore, William Wood & Company, 1939, p. 183.

cartilage (fig. 15 *B*). Two mattress sutures of silk are passed through both flaps of mucoperichondrium and septal cartilage (fig. 15 *C*). The mucoperichondrial flaps on each side are reunited to the skin of the columella with no. 5-O atraumatic dermal sutures to eliminate all exposed raw surfaces (fig. 15 *D*).

The nasal fossae are packed with petrolatum gauze under sufficient pressure to apply the membrane to the cartilage graft. Collections of secretions or the development of hematomas is prevented by the absence of dead spaces and the dependent drainage. The sutures are removed on the fourth or fifth day.

There is little danger of the cartilage graft not "taking." Autogenous cartilage is nourished by lymph and therefore immediately receives nourishment through imbibition. It retains its original form and does not become absorbed or tend to shrink or disintegrate. While it is true that partial replacement by dense fibrous tissue may take place, nevertheless these changes as a rule do not alter the architecture of the graft. While

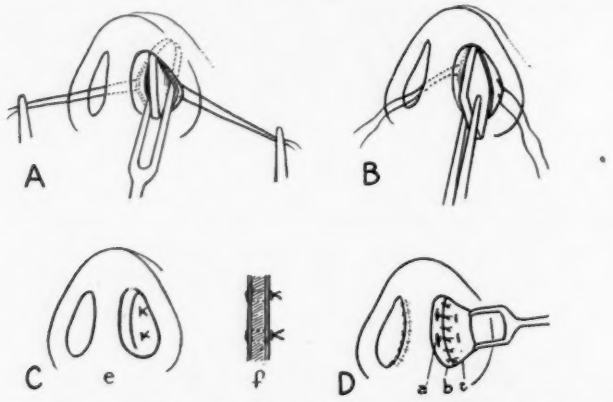

Fig. 15.—*A*, removal of the deflected septum with a swivel knife. *B*, cartilage inserted and covered by mucoperichondrial flaps. *C*, showing *e*, cartilage secured in place by mattress sutures, and *f*, sectional view. *D*, raw surfaces approximated, showing *a*, mattress sutures securing graft in place; *b*, atraumatic sutures uniting mucoperichondrial flaps to columellar skin, and *c*, sutures holding grafts to mucoperichondrial flaps.

isografts are foreign bodies, they are well tolerated by the tissues and evoke but slight foreign body reaction.

The purpose of the cartilaginous replacement is not to furnish support, since the graft, having no abutment above or below, can sustain no weight. Like the columellar "batten," it is replaced to prevent contraction of the connective tissue in the process of healing and thus eliminate the consequent distortion and saddling of the dorsum. Physiologically, such reconstruction of the septum would appear more effective, since it restores the rigidity of the partition and counteracts the ballooning effects of peak-positive and peak-negative pressures during respiration.

Details of the operative procedure may be modified by the ingenuity of the surgeon. For example, when the septal deflection is not to be corrected as a part of a rhinoplastic operation, we prefer Dr. Thomas Galloway's modification of the operation, which is as follows: An incision is made in the membranous septum as previously described

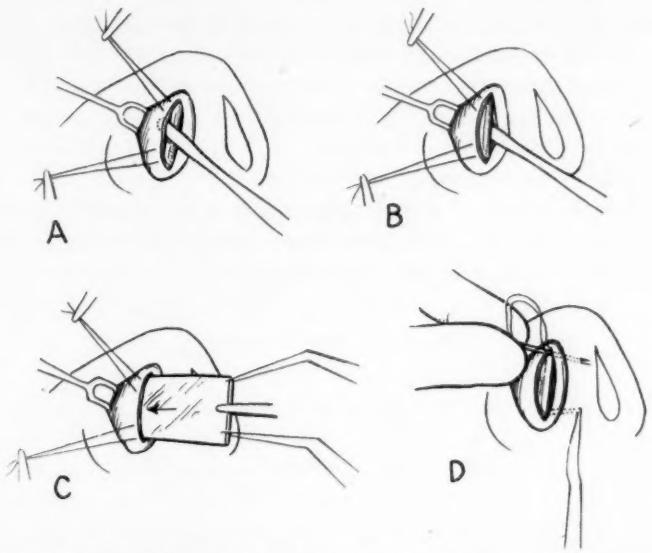

Fig. 16.—*A*, mucoperichondrial flap held aside with two mattress sutures and elevated. *B*, mucoperichondrial flap on opposite side elevated. *C*, cartilage introduced between flaps. Two double-armed sutures passed through the cartilage to pilot the graft into the columellar bed. *D*, twin needles passed through the columellar skin.

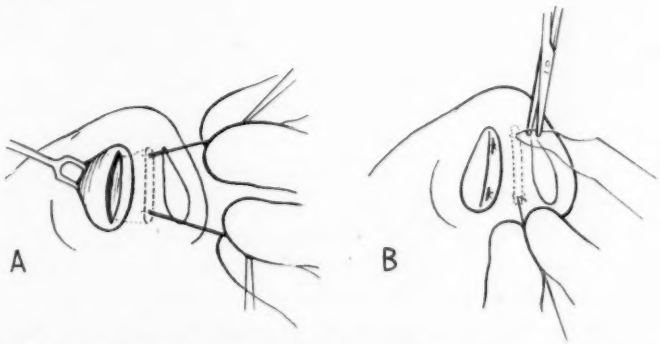

Fig. 17.—*A*, traction exerted on sutures to draw cartilage into the columellar bed. *B*, cartilage fixed into the columellar bed with two mattress sutures. Pilot sutures removed.

(fig. 10*A*). A bed is created in the columella as shown in figure 10*B*. Two silk sutures are passed through the mucoperichondrium, and the membrane is elevated on one side (fig. 16*A*). The mucoperichondrium

on the opposite side is elevated in a like manner (fig. 16 *B*). The septal cartilage is removed with a scissors or swivel knife (fig. 15 *A*).

To overcome the subsequent tension forces arising from the contraction of the deskeletonized membrane, Dr. Galloway employs the following procedure: Either the resected septal cartilage, if usable, or the preserved cartilage is reinserted. Two pilot sutures are passed through the caudal end of the cartilage. The cartilage graft is then introduced between the membranes until lost from view (fig. 16 *C*). The suture ends emerging from the cartilage are armed with four straight needles, introduced into the previously prepared bed and brought out to the surface at the center of the columella (fig. 16 *D*). Traction is exerted by the assistant to draw the cartilage into the columellar bed, where it is fixed by two mattress sutures passing through the full thickness of the columella and graft (fig. 17). The pilot sutures, having subserved their purpose, are withdrawn (fig. 17 *B*).

MODIFIED RADICAL MASTOIDECTOMY: THE INDICATIONS AND THE TECHNIC

(Semiradical Mastoidectomy, Modifed Tympanomastoidectomy, Heath Mastoidectomy, Bondy Mastoidectomy)

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IN THE discussion of the modified radical mastoidectomy I should like to say that I subscribe in a large part to the ideas expressed by Wittmaack in his discourse on pneumatization of the temporal bone.

Pneumatization of the temporal bone begins soon after birth, usually within the first twelve months, and is almost completed by the fourth or fifth year of age. Some pneumatization takes place all through life.

If infection of the middle ear takes place in infancy or before the end of the fourth or the fifth year of age, pneumatization is definitely disturbed, resulting in no pneumatization if the infection is early and of a severe type, or partial if the infection takes place after the normal pneumatization has begun or if the infection is of a less severe degree. The amount of pneumatization is determined by the severity of the infection and especially the stage in the processes of pneumatization at which the infection occurs.

The mucous membrane covering the tympanum, the antrum and the poorly developed cells is entirely different from the mucous membrane of the normal middle ear. In the mastoid process in which pneumatization has been completely or to a marked degree arrested the mucosa of the tympanum, the attic, the antrum and the cells is hyperplastic, being much thicker than normal, is covered with cuboid epithelial cells in more than one layer and may have ciliated epithelium in some areas. The submucosa may be separated into several layers, some of which may be myxomatous in type. There may be abnormal bands of connective tissue, cysts and other anomalies. This type of mucous membrane is much more vulnerable to infection than the normal.

The large majority of conditions for which the modified radical mastoidectomy is indicated are in temporal bones in which there is partial or no pneumatization. It should be understood though that this procedure is not contraindicated in well pneumatized temporal bones. A well pneumatized mastoid process with its normal mucous membrane is not so vulnerable to infection as the opposite type and if it were properly treated the infection would less frequently become chronic.

It might be said that the nonpneumatized temporal bone with a small attic and with few or no cells in the roof of the attic between the tegmen tympani and this cavity makes the operative procedure more difficult than if there are cells with ample space for operative maneuvers.

The modified radical mastoidectomy has for its main purpose the removal of a large part or all of the existing pathologic processes and the preservation of the membrana tympani and if possible the ossicular chain. The annulus tympanicus may or may not be preserved. The pathologic involvement at times may necessitate removal of the incus or the head of the malleus or both. Some of the more important indications are:

1. Chronic suppurative otitis media with pathologic processes which can be entirely or in a large part eradicated through this approach.

2. Hearing acuity.

   (*a*) Hearing should be good or quite satisfactory to the patient.

   (*b*) If both ears are involved, this procedure is indicated even though the hearing is bad.

   (*c*) If hearing is bad or there is no hearing, there is no indication for conservatism.

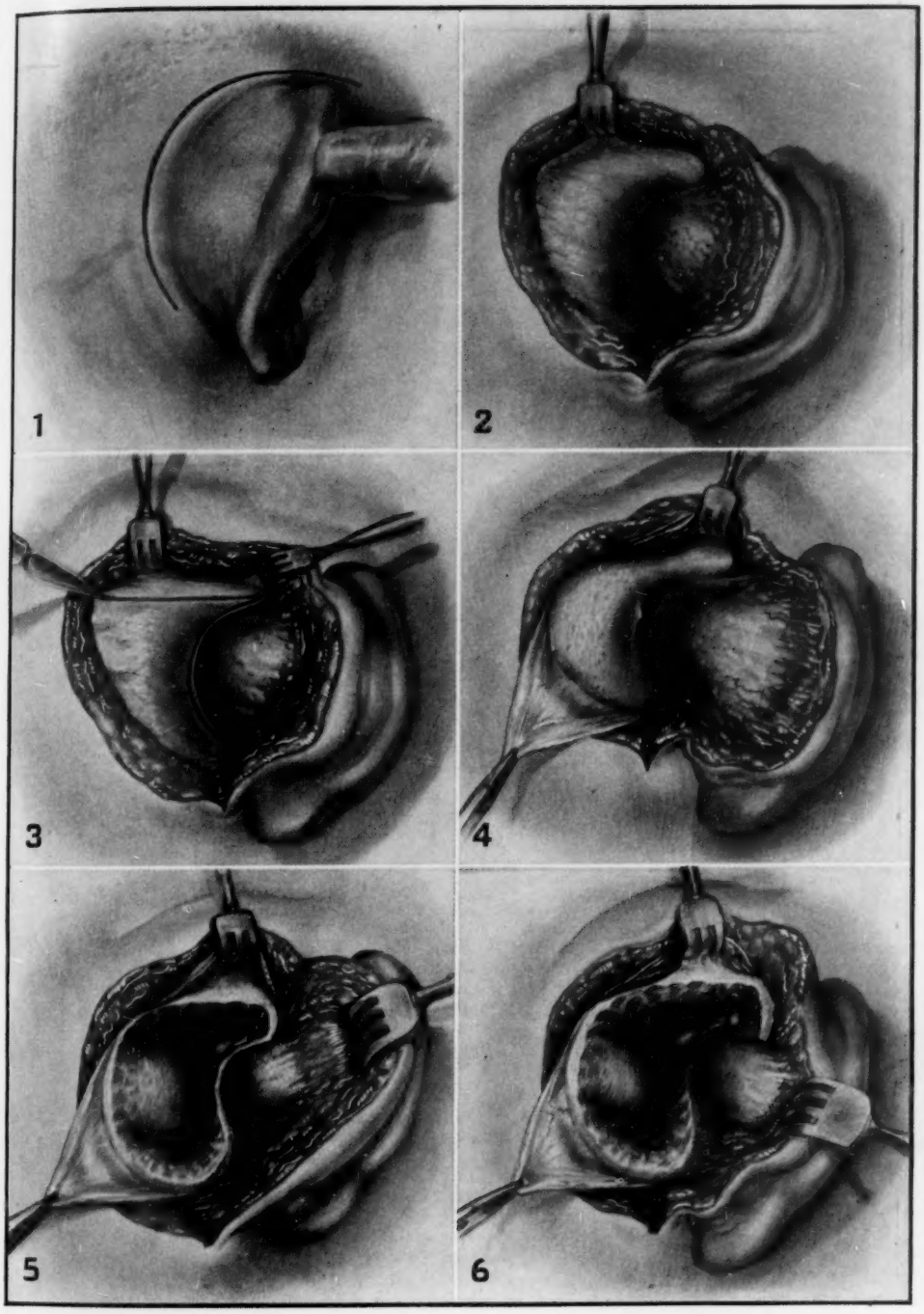
   (*d*) The hearing after the modified radical mastoidectomy should be the same or better than before the operation.

3. It seems to me that this procedure is not indicated in the ordinary acute mastoiditis, but in an acute exacerbation of chronic mastoiditis it may be indicated, although it is usually more satisfactory to operate in a quiet period.

4. A central perforation with chronic suppuration has at times been said to be a contraindication for any operative procedure but many of the patients with such a lesion can be entirely relieved of the discharge and all symptoms by this procedure. There may be little pathologic change in the eustachian tube, but there is usually an infection in the attic, the antrum and the cells of the mastoid bone and by its removal the chronic suppuration is relieved with a dry ear as the final result.

5. In all cases of attic or marginal perforations, with hearing as indicated in paragraph 2, with or without cholesteatoma, if all the cholesteatoma and all or most of the pathologic involvement can be eradicated, the modified radical mastoidectomy is indicated.

The technic of this modified radical mastoidectomy will be given step by step, with some of the more important phases being illustrated with drawings.



1, the incision of the skin. *2*, the soft tissues dissected anteriorly to the membranous canal; the periosteum intact. *3*, the incision of the periosteum. *4*, the mastoid exposure prepared for removal of bone. *5*, the completed simple mastoidectomy. *6*, the attic and its contents exposed.

Further Explanation of Steps of Operation

In *1* the cutaneous incision, which should extend only to the periosteum, is carried rather far anteriorly so that visualization of the attic is satisfactory.

In *2* the skin and soft tissue superficial to the periosteum are dissected anteriorly to the membranous canal, also superiorly and inferiorly to the canal, the surgeon being sure that the membranous canal is not torn.

(Legend Continued on Next Page)

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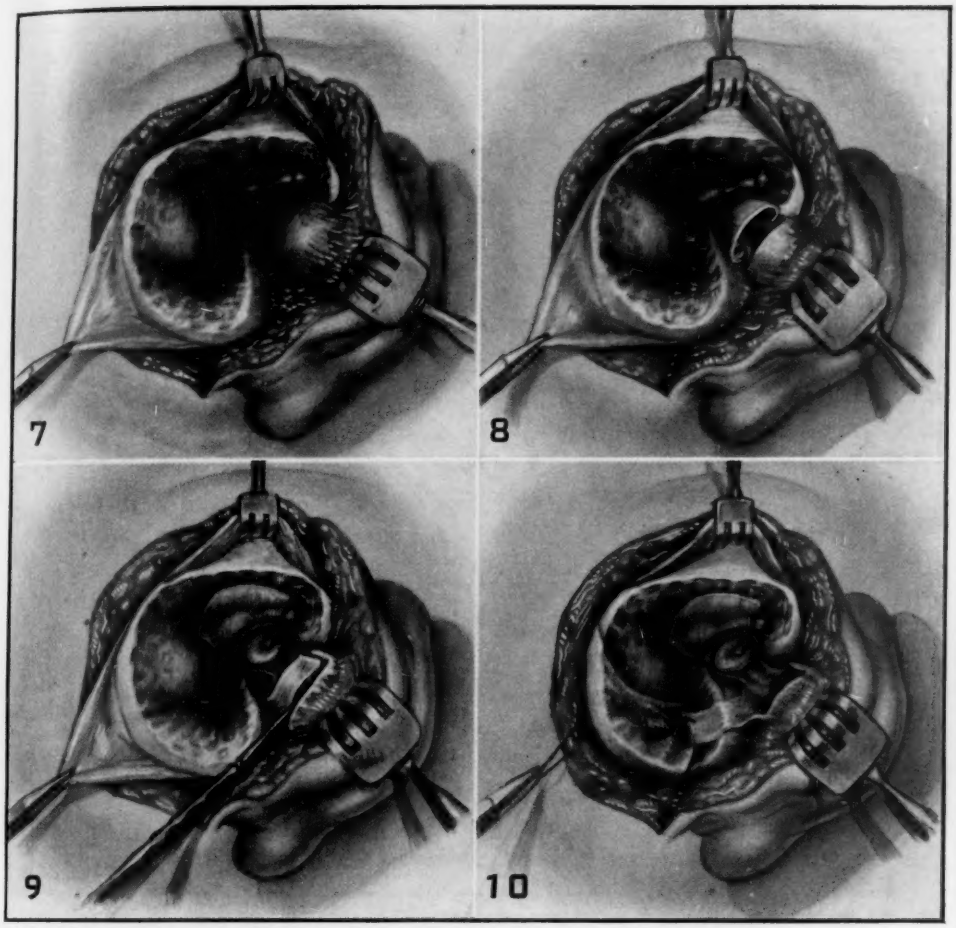

In *3* the incision of the periosteum is made superiorly in a horizontal direction and posteriorly directly around the membranous canal. The periosteum is now elevated and retracted posteriorly and inferiorly.

In *4* the temporal muscle is retracted superiorly and the periosteal flap inferiorly and posteriorly so that good visualization of the mastoid area, including the root of the zygoma, is obtained.

In *5* the simple mastoidectomy is completed with gouges, curets, burrs, rongeurs or whatever instruments the surgeon selects.

In *6* the superior and posterior walls of the meatus down to the annulus tympanicus with the posterior root of the zygoma are removed. Visualization of the attic, the ossicles and the pathologic involvement in this region is now possible.

7, exposure of the attic with the annulus tympanicus removed. *8,* cutting of the internal flap of the membranous canal. *9,* internal flap in its final position; cutting of the external flap. *10,* both internal and external flaps in final positions.

The removal of the pathologic content of the attic and the middle ear may be facilitated by the resection of the annulus tympanicus. Rarely the removal of the incus is indicated. (See *7.*)

Skin flaps have been very helpful in the healing following the modified radical mastoidectomy. Two flaps are utilized: an internal and an external flap. First the flap of the internal part of the canal is made and is best understood and visualized from the drawing. (See *8.*)

In *9* the placing of the internal flap and the cutting of the second or external flap is being completed.

In *10* the periosteal flap is laid anteriorly and superiorly over the bone. A suture may be placed in the tip of the external flap through the periosteal flap which has been drawn anteriorly and superiorly, fixing both of these structures in their proper positions, the skin flap being superficial to the periosteal flap. It is not always necessary to apply a suture. The flaps have little tendency to get out of their correct positions. After the flaps are cut and fixed in the desired positions, they are covered with gauze and left six to ten days. No further packing is necessary.

Frequent cleansing of the ear cavity should be carried out until the epithelization is complete.

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TRAUMATIC PALATAL FISTULA

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AND
LIEUTENANT COMMANDER JOHN C. HOWARD (MC), U.S.N.R.

BULLET and shrapnel wounds of the face frequently penetrate the osseous walls of the maxillary antrum or the floor of the nasal fossae. Ranging downward in their course, these foreign bodies pass through the roof of the mouth, creating large and frequently multiple defects in the hard palate. These deficiencies may represent oronasal or oroantral fistulas.

This type of injury is commoner than is generally supposed, because the face is the one part of the head that is unprotected by the helmet. A great many wounds of the face are due to sniper fire from an elevation such as a tree or a hill, which gives the bullet its characteristic downward course. The thick walls of the malar and the maxillary bone afford some measure of protection to the tongue and other contents of the oral cavity, as in most instances the velocity of the projectile is spent somewhat in its passage through these osseous structures. The traumatic types of oroantral and oronasal fistulas are of great interest to the otolaryngologist from a surgical standpoint inasmuch as each case presents a technical problem that must be worked out by the operator's own ingenuity. A review of the standard textbooks in otolaryngology gives little or no information on the subject, and one must turn to publications on oral surgery for enlightenment. It is surprising that more attention is not paid to this type of fistula, as it is certainly a rhinologic problem, one of the prime prerequisites for successful treatment being the management of pathologic conditions of the nose or of the sinuses, or of both.

Oroantral fistulas of dental origin are not infrequent in civilian practice. Neoplasms, syphilis, tuberculosis and radium implants also may produce this type of defect. Oronasal fistulas are uncommon. They are usually found in association with trauma or with cancer of the nose. Palatal defects of traumatic origin are usually larger, varying in size, shape, location and number. Figure 1, in which five separate and distinct fistulas are seen, illustrates the bizarre pattern which the roof of the mouth may present in these cases.

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Most of these men were seen three to six months after their injury. Considerable scarring with occasional spontaneous closure of the smaller fistulas was frequently in evidence. This was to be expected with service personnel, since most of the patients fall into the younger age groups. In nearly all instances there was good to acceptable dental hygiene. The general physical and mental makeup of the men returning from the combat areas varied somewhat, because of battle wounds, fatigue, etc.

The treatment of antral fistulas secondary to war wounds may differ from that of the conventional dental type although the basic surgical principles remain the same. This difference in the operative approach is necessary because the fistulas of traumatic origin vary in size and anatomic location in the roof of the mouth. Fistulas may range from pinpoint size perforation to avulsion of the greater part of the hard palate. The multiplicity of the fistulas is another factor with which the operator must contend in treatment of this condition. Traumatic wounds of the roof of the mouth have a tendency to become surrounded by a thick layer of fibrous tissue, which complicates the problem of supplying blood to the transplanted flap. Frequently defects in the palate lie close to one another, separated only by a thin bridge of bone covered with the palatal mucoperiosteum. These ridges form a precarious area on which to anchor flaps in covering adjacent fistulas. Failure of a transplant to "take" leaves the surgeon hard pressed to find tissues available for subsequent procedures. Frequently wounds in other parts of the body strain the recuperative powers of the patient, thus slowing down the healing time. Antral contamination by food particles, along with preexisting pathologic conditions of the sinus, creates a situation similar to that met in the usual dental type of fistulas.

Treatment of oroantral and oronasal fistulas of traumatic origin may be divided into a medical and a surgical phase:

MEDICAL TREATMENT

Medical treatment precedes and acts also as an adjunct to the surgical phase. The patient must first be subjected to a thorough physical examination, and any pathologic condition present should, if possible, be eradicated. A high vitamin diet is ordered, complemented with multivitamin capsules containing the required minerals, because many of the patients returning from overseas have been found to be in poor physical condition, showing definite evidence of dietary deficiencies. This was particularly true of patients seen in the early part of the war. A complete blood count is ordered to determine whether any degree of anemia is present. A careful history is taken in regard to tropical diseases. A smear of the blood is examined in all cases for parasites of malaria, as experience with this disease has shown that there is a tendency for the healing process to be impaired. In this type of patient surgical proce-

dures have a tendency to precipitate an acute exacerbation of latent or quiescent malaria. It is certainly disconcerting to observe a sudden unexplained rise in temperature accompanied by chills immediately following surgical treatment.

Studies of the antrum and the fistulous tract by means of contrast mediums are routine, as this procedure not only gives a picture of the defect but also helps to evaluate any pathologic condition present in the antrum. Careful roentgenologic studies are made in search of any foreign body that might still be present in the maxillary sinus.

A dental consultation is ordered with a view to improving the oral hygiene. Carious teeth are filled or extracted. Smears are taken from the gingiva to insure against the presence of any fusospirochetal infection. Instructions are given to massage the mouth and gums several times daily to increase the blood supply to this area.

When sinus infection is found, appropriate treatment is instituted. An effort is made to determine the duration of the pathologic condition of the sinus, to determine whether the infection has existed for a number of years, or had its origin following the wound. Cases of sinusitis of long standing make the problem much more difficult.

SURGICAL PROCEDURE

Before any operation is performed, a thorough study is made in each case, and a suitable plan of attack is outlined. A surgical procedure of choice should accomplish a twofold purpose, first, the closing of the fistulous tract and, second, the preservation of the future health of the involved antrum.

The operative procedure may be divided into two stages, first, surgical treatment of the antrum, and, second, the actual closing of the fistulous tract.

In the first stage, if no pathologic condition of the sinus exists, a nasoantral opening is made beneath the inferior turbinate to insure adequate drainage and to take care of any secondary inflammation that might result from the operative procedure on the palate. This type of surgical treatment of a sinus is done about two weeks before the fistula is closed. When there is severe antral disease with a greatly thickened mucoperiosteum and with polyp formation, a Caldwell-Luc operation is the procedure of choice. This, of course, delays palatal repair for a considerable period.

The operative approach in the second stage, that of palatal repair, depends on several factors. When there are multiple large defects, each fistula requires a separate operation for closure, as experience has demonstrated that an attempt to close two or more fistulas simultaneously may result in embarrassment of the blood supply to the transplant. Small fistulas frequently close spontaneously, without any treatment, or respond

nicely to the curettage of the tract followed by the application of silver nitrate. These smaller fistulas can often be closed in conjunction with the repair of a larger defect, as the impairment of the blood supply is minimal when the fistulas are small. Figure 1 is an excellent example of this, as of the five fistulas present two closed of their own accord, and one required curetting with the application of silver nitrate, which was done simultaneously with the closing of the alveolar fistula. The fifth defect required a separate operation. When fistulas are multiple, several weeks must elapse between operations. A single oral fistula of the antrum or the nose may be closed by any of the accepted types of flaps, such as those advanced by Ashley, Dunning or Weltly. No discussion of oroantral fistulas is complete without mention of the dental variety. We have seen a number of these in our series, and they still comprise a most frequent type. Like fistulas of traumatic origin this variety is also on the increase. This is due to the fact that for the first time millions of men who had comparatively little dental care previously have found themselves under treatment in service dental departments. This greater dental surveillance has brought about an increased number of extractions with a resulting rise in the frequency of oroantral fistulas.

At this hospital about 30 per cent of the patients treated were wounded overseas, the remainder being recent inductees in the midst of recruit training. This situation has given us an excellent opportunity to study both types of fistulas. Two typical cases of oroantral fistulas due to face wounds and one of the commoner dental type are presented.

REPORT OF CASES

CASE 1.—This patient, a marine aged 21 (fig. 1), received a shrapnel wound of the face in August 1944. The projectile entered just below the malar bone and passed through the left antrum and the roof of the mouth, leaving five separate and distinct defects in the hard palate. The patient was received at this hospital in January 1945, and at that time examination revealed the five oroantral fistulas in the roof of the mouth, all draining freely. Roentgenograms showed that all sinuses were clear but that the mucous membrane of the left antrum was slightly thickened. A removable appliance of acrylic resin was fitted to the roof of the mouth, thus preventing food particles from entering and reinfecting the left maxillary sinus. In March, after the patient's physical condition had been built up and appropriate laboratory studies had been made, a nasoantral opening into the left antrum was made. Two weeks later the alveolar fistula was closed by means of an Ashley flap. At this time one of the small fistulas was curetted, and silver nitrate was applied. The postoperative recovery was uneventful, and two of the small fistulas closed spontaneously. Six weeks after this the large palatal fistula was repaired, and six weeks later there was no leakage apparent. The man was subsequently returned to duty.

CASE 2.—This patient, a marine aged 19, received a 25 caliber bullet wound in the face (fig. 3). The projectile entered the left malar bone and passed completely through the left maxillary sinus, entering the nasal fossae. Here the foreign body was deflected downward and continued on through the roof of the mouth.

The bullet finally buried itself in the right cheek. Teeth 8, 9, 10, 11 and 12 were injured and subsequently were extracted aboard a hospital ship. The patient entered this hospital two months after injury. Examination and studies of the tract by means of iodized poppyseed oil 40 per cent revealed a nasoantral and an oroantral fistula. Roentgenograms of the sinuses showed the left antrum to be in

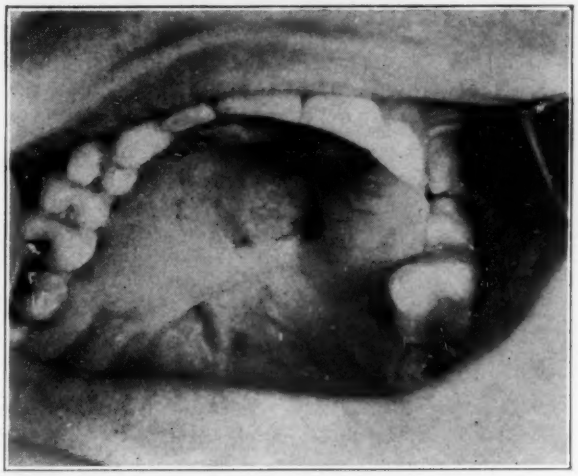

Fig. 1 (case 1).—A view of the palate, showing five distinct and separate fistulas.

Fig. 2 (case 1).—A view of the palate, showing closure of all fistulas.

good condition, the antral nasal fistula affording good drainage for the sinus. After appropriate dental treatments, a flap closure of the oral fistula was made. The patient had an uneventful postoperative recovery and was returned to duty.

CASE 3.—This patient, a warrant officer aged 49, had had teeth 14 and 15 extracted in January 1942, after which a large oroantral fistula persisted. A

Fig. 3 (case 2).—Oronasal antral fistula due to a bullet wound.

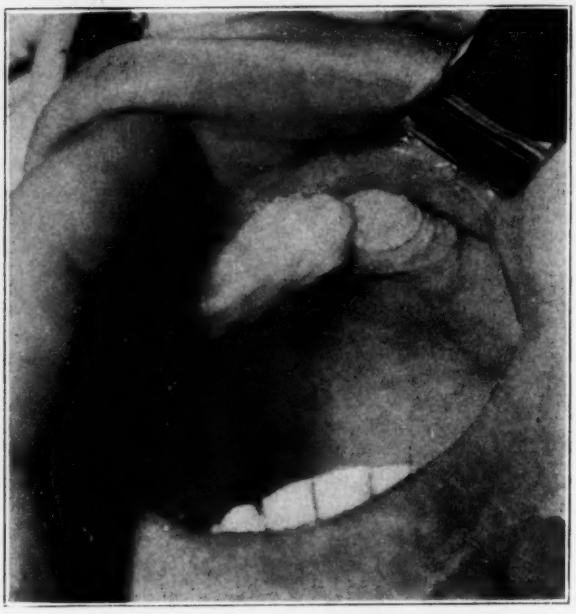

Fig. 4 (case 2).—A view of the palate three weeks after closure of the oro-antral nasal fistula.

Caldwell-Luc operation was performed on the left antrum in September 1943. At this time an attempt made by the attending oral surgeon to close the fistula was unsuccessful. In November a palatal flap of the Ashley type was swung over the deficiency and the deepithelized tip forced up into the fistulous tract. Complete closure of the fistula followed, and within four weeks the man was wearing a removable palatal bar denture.

SUMMARY

Oroantral and oronasal fistulas may result from bullet and shrapnel wounds of the face.

Fistulas of this traumatic origin differ from the conventional dental type in that they may range from pinpoint size perforations to an avulsion of the greater part of the palate.

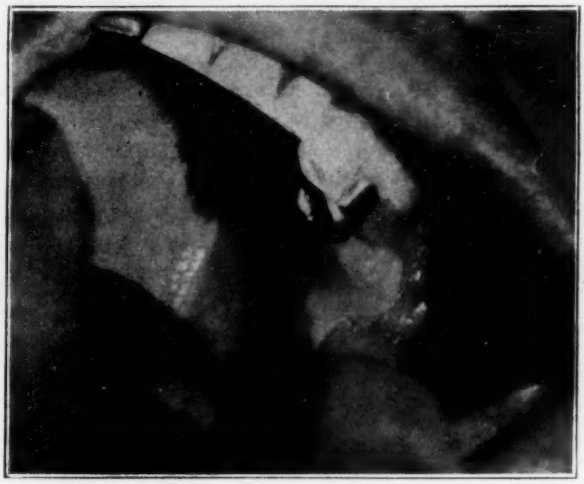

Fig. 5 (case 3).—Closure of dental type of oroantral fistula.

These defects, frequently multiple, may be located anywhere in the roof of the mouth.

The surgical procedure must be tailored to fit the individual case.

CONCLUSION

In this day, as the otolaryngologist sees the surgical aspect of his field approaching an absolute minimum, more consideration could be given by the specialist to a not too uncommon oral-nasal disturbance, namely the oroantral fistula. Because of the definite association of this condition with the nose and the maxillary sinus, corrective surgical procedures certainly must come within the province of the rhinologist.

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ABSENCE OR NEAR ABSENCE OF EXCITANT EFFECTS FROM ADMINISTRATION OF TUAMINE

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AND
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THE LOCAL use of decongestive agents in the nose has been popular for many years in the symptomatic treatment of a "running nose" or "stuffed-up nose" in allergic rhinitis, catarrhal rhinitis and allied conditions. At present, the most commonly used drugs are sympathomimetic amines, such as amphetamine or ephedrine or neosynephrine hydrochloride. Sympathomimetic amines which are volatile at room temperature, such as amphetamine, may be applied as inhalers, which is a convenient form of medication. A nonvolatile drug, or one nonvolatile at room temperature, is usually converted into the water-soluble hydrochloride or sulfate and used as "drops" or sprayed on the congested mucosa with the aid of a nebulizer. A similarly acting drug, chemically related to histamine, is 2-naphthyl-methyl imidazoline hydrochloride (privine hydrochloride). In recent years, a third group has been introduced, chemically being aliphatic amines, of which tuamine, (2-aminoheptane) is an example. Tuamine has the advantage that it is volatile and may be administered in the form of an inhaler. One might mention that there is a fourth group of miscellaneous drugs, older compounds such as compound tincture of benzoin (friars' balsam) and camphor, which enjoyed considerable popularity in their day but which have not been studied or investigated by modern pharmacologic and therapeutic technics.

The weight of evidence indicates that these drugs afford symptomatic relief only and are not curative. For example, Boyd and Connell [1] reported that the use of amphetamine as an inhaler gave relief from nasal turgescence but did not shorten the length of a common cold. Relief from a "running nose" or "stuffed-up" nose is a definite boon to the person so afflicted, and these drugs have come to assume a legitimate

From the Department of Pharmacology, Queen's University. This work was aided financially by grants from the Banting Research Foundation and from Eli Lilly and Company.

1. Boyd, E. M., and Connell, W. F.: Vasoconstrictor Properties of Benzedrine and Its Use in the Relief of the Common Cold, Am. J. M. Sc. **194**:678-682 (Dec.) 1937.

place in the therapeutic armamentarium. Their excessive use, like excessive use of any drug, leads to toxic reactions; thus Boyd [2] has shown that amphetamine, ephedrine, neosynephrine and like compounds have a toxic effect on the ciliated mucosa when used in excess. Fortunately, this effect is ordinarily temporary and disappears when the drug has been diluted or washed away by the mucosal secretions. Sometimes the diluting of the drug is followed by a secondary congestion, which may be worse than the initial, but a second application of the decongestive agent will ordinarily take care of this.

A more serious and annoying toxic effect is the excitant action on the central nervous system of some sympathomimetic amines, such as amphetamine, when used in excess and in quantities sufficient to permit of absorption of amounts of the drug which will give rise to this undesired reaction. Such excessive use near bedtime may be a cause of insomnia. Since volatile drugs for the relief of nasal congestion are the more convenient and popular, and since tuamine is such a preparation, it was decided to investigate whether tuamine has any excitant effect on the central nervous system. This has been done in two ways. First, the effect of various doses of tuamine on the activity of albino rats has been studied, by means of activity wheels. Secondly, rats, mice, guinea pigs, rabbits and cats have been narcotized with pentobarbital sodium, and the effect of tuamine on the depressed respiratory rate and depressed reflexes studied. The physical activity of unanesthetized rats was, if anything, depressed by tuamine. With the anesthetized animals the results were variable, but no considerable analeptic action was recorded. These results suggest that tuamine has a dual advantage in that it may be used conveniently as an inhaler, being volatile, and that, secondly, it has little or no excitant effect on the central nervous system even in doses much larger than those ordinarily absorbed from local application to the nose. To these advantages may be added a third, from the observations of Proetz,[3] that therapeutic doses of tuamine have no deleterious effect on activity of ciliated mucosal surfaces.

TUAMINE AND PHYSICAL ACTIVITY OF UNANESTHETIZED ANIMALS

Five groups of male albino rats were placed in activity wheel cages (George H. Wahmann Mfg. Co., animal cage LC34), given a diet of Purina Fox Chow Checkers and water ad libitum. The animal in cage 1 acted as a control and was given an intramuscular injection of isotonic solution of sodium chloride. The animals in cages 2 to 5 received a similar injection of saline solution containing various doses of tuamine sulfate, as listed in table 1. These doses, from

2. Boyd, E. M.: The Effect of Benzedrine on Ciliary Movement, Am. J. M. Sc. **196**:44-46 (July) 1938.

3. Proetz, A. W.: 2-Amino-Heptane Sulphate as a Nasal Vasoconstrictor, Ann. Otol., Rhin. & Laryng. **51**:112-116 (March) 1942; Certain Aliphatic Compounds as Nasal Vasoconstrictors, Arch. Otolaryng. **37**:15-22 (Jan.) 1943.

1 to 10 mg. per kilogram of body weight, corresponded to from one fiftieth to one fifth the LD_{50} dose. The time of injection was noted, and the number of revolutions of the activity wheels were recorded (*a*) for the first five hours after injection and (*b*) from the end of the fifth to the end of the twenty-fourth hour, the latter interval covering the evening, night and early morning, i. e., those hours when the rats, being nocturnal in habit, are ordinarily most active. The ergs of work required to turn the activity wheel were determined, and since these varied from wheel to wheel and also since physical activity is subject to considerable variation, to cancel out these factors as much as possible, after each twenty-four hour period each rat was transferred from one activity wheel to the next, until by the end of the experiment each rat had been attached to each activity wheel. This experiment was then repeated to the number of times indicated in table 1. The total number of ergs of work done during the two periods was then found and expressed as millions of ergs per rat per hour, and these results have been listed in table 1.

TABLE 1.—*The Effect on Physical Activity as Measured in Activity Wheels of Tuamine Sulfate Given Intramuscularly to Albino Rats*

Dose of Drug (Mg. per Kg.)	Hours After Injection	Number of Animals	Work Done (Millions of Ergs per Rat per Hour)
0.0	0 to 5*	61	5.6
1.0	0 to 5*	58	3.3
2.0	0 to 5*	58	3.1
5.0	0 to 5*	58	2.9
10.0	0 to 5*	58	2.8
0.0	5 to 24†	53	6.5
1.0	5 to 24†	49	6.4
2.0	5 to 24†	50	5.4
5.0	5 to 24†	43	5.3
10.0	5 to 24†	50	4.0

* Daytime hours.
† Nighttime hours.

During the first period of five hours the control rats performed an average of 5,600,000 ergs of work per rat per hour. Rats given tuamine sulfate performed less and less work as the dose of the drug increased, so that those animals receiving 10 mg. of tuamine sulfate per kilogram of body weight did exactly half as much work as did the controls. During the night period, from five to twenty-four hours after injections, all of the rats were more active, and, while there was less difference between the means of the five groups, what difference did occur was of the same order qualitatively as during the initial five hour period.

In the experiment outlined it was noted that the rats were excited and active for a few hours after injections and then quieted down. To investigate these initial changes in activity more thoroughly, the experiment was repeated, but readings of the revolutions of the wheels were made at the end of two, four and six hours after injection. The animals were rotated, the experiments were duplicated and the results were calculated as before and recorded in table 2. In this variation, injection

of tuamine sulfate also had a quieting effect during the first two hours after administration, after which all of the rats exhibited less activity.

The conclusion to be drawn from these experiments is that intramuscular injections of tuamine sulfate, in doses up to 10 mg. per kilogram of body weight, which is approximately one fifth the LD_{50} dose of tuamine sulfate for rats, certainly do not increase the physical activity of normal, unanesthetized albino rats. In view of the results obtained on anesthetized animals and to be described, it is doubtful if too much emphasis should be placed on the finding of an apparent depression of physical activity.

TUAMINE AND RESPIRATORY ANALEPSIS

Most excitants of the central nervous system, such as amphetamine, act as analeptics toward depressed respiration. Respiratory depression

TABLE 2.—*The Immediate Effect on Physical Activity as Measured in Activity Wheels of Tuamine Sulfate Given Intramuscularly to Albino Rats*

Dose of Drug (Mg. per Kg.)	Hours After Injection	Number of Animals	Work Done (Millions of Ergs per Rat per Hour)
0.0	0 to 2	100	13.2
1.0	0 to 2	100	9.6
2.0	0 to 2	100	8.9
5.0	0 to 2	100	6.7
10.0	0 to 2	100	5.6
0.0	2 to 4	100	1.7
1.0	2 to 4	100	1.2
2.0	2 to 4	100	2.0
5.0	2 to 4	100	1.7
10.0	2 to 4	100	2.5
0.0	4 to 6	100	0.7
1.0	4 to 6	100	0.4
2.0	4 to 6	100	0.3
5.0	4 to 6	100	0.3
10.0	4 to 6	100	0.4

was induced in a series of 100 albino rats, 50 guinea pigs, 50 white mice, 25 rabbits and 10 cats by intraperitoneal injection of pentobarbital sodium in doses sufficient to produce narcosis and anesthesia for about two hours, these doses being stated in table 3. Five groups of animals were used, each group being given the stated dose of pentobarbital sodium, which effectively depressed the respiratory rate. Equal numbers of animals in each group were studied each day to eliminate or equalize the many factors which are involved.[4] Exactly twenty minutes after the injection of pentobarbital sodium, animals in group 1 were injected with isotonic solution of sodium chloride and in groups 2 to 5 with one fiftieth, one twenty-fifth, one tenth and one fifth of an LD_{50} dose of tuamine sulfate respectively. The LD_{50} dose of the drug had been previously found for each species. The various actual fractions of the LD_{50}

4. Goodwin, L. G., and Marshall, P. B.: A Method for the Determination of Analeptic Activity, J. Pharmacol. & Exper. Therap. **84**:12-15 (May) 1945.

dose are stated in milligrams per kilogram of body weight in table 3. The respiratory rate (per minute) was determined at intervals of twenty minutes for one hundred minutes from the time of injection of tuamine sulfate, and the averages of these readings are recorded in table 3.

As may be seen, the effect of tuamine sulfate was a variable one. Where changes were recorded, they were mostly of a minor degree. A

TABLE 3.—*The Effect of Tuamine Sulfate Injected Intramuscularly on the Respiratory Rate of Animals Anesthetized with Pentobarbital Sodium*

Dose of Tuamine Sulfate, Mg. per Kg.	Respiratory Rate, Minutes After Injection of Tuamine				
	20	40	60	80	100
100 Albino Rats Given 40 Mg. of Pentobarbital Sodium per Kilogram					
0.0	72	65	64	71	75
1.0	72	64	64	69	70
2.0	71	70	71	72	70
5.0	66	73	76	74	75
10.0	70	78	75	71	77
50 Guinea Pigs Given 30 Mg. of Pentobarbital Sodium per Kilogram					
0.0	42	44	44	50	55
1.5	43	49	58	58	63
3.0	36	43	52	58	68
7.5	35	37	48	56	56
15.0	31	46	47	55	55
50 White Mice Given 100 Mg. of Pentobarbital Sodium per Kilogram					
0.0	75	67	76	111	126
1.2	71	68	78	110	126
2.4	74	76	86	121	130
6.0	71	71	95	102	110
12.0	78	63	67	78	81
25 Rabbits Given 40 Mg. of Pentobarbital Sodium per Kilogram					
0.0	14	29	33	35	30
1.0	24	41	33	31	32
2.0	29	58	35	37	42
5.0	18	25	32	32	29
10.0	19	27	35	33	37
10 Cats Given 35 Mg. of Pentobarbital Sodium per Kilogram					
0.0	18	14	14	14	14
1.0	18	19	28	28	28
2.0	20	19	26	32	34
5.0	15	19	26	26	28
10.0	22	30	40	46	40

definite respiratory analeptic action was seen in rats and cats. In cats the effect was quite noticeable, especially with the larger doses of tuamine sulfate—doses, it may be noted, which were many times the therapeutic dose. In the other species, guinea pigs, white mice and rabbits, there was a tendency for the small, but not the large, doses of tuamine sulfate to produce respiratory analepsis. It may be concluded, therefore, that in animals anesthetized with pentobarbital sodium injec-

tions of tuamine sulfate have variable and, for the most part, minor effects, with some evidence of a mild respiratory analepsis.

TUAMINE AND RESTORATION OF REFLEXES IN ANESTHETIZED ANIMALS

Another evidence of excitation of the central nervous system is the rapid restoration of various reflexes which have been depressed or have disappeared under the influence of the anesthetic drug. While tuamine sulfate seemed to have some respiratory analeptic action in anesthetized animals, the results or effects on the reflexes of these animals were not as clearcut. Using the same animals as were studied for respiratory analepsis, two reflexes were selected for investigation, the conjunctival reflex and the righting reflex. The number of minutes during which each of these reflexes was absent after injection of tuamine was determined for each of the animals studied for respiratory analepsis, and the average results have been summarized in table 4.

The conjunctival reflex was restored more quickly in albino rats and in cats which had been given tuamine sulfate. In guinea pigs, white mice and rabbits, tuamine sulfate did not have much effect on the speed of restoration of the conjunctival reflex. In none of the five species did tuamine sulfate have much effect on the time of restoration of the righting reflex. Figures for the duration of absence of the righting reflex in the cat have not been included in table 4 because it was impossible to determine with certainty the exact time this reflex was restored in this species.

The results of this study, though not as consistent as one would have liked, permit of the conclusion that tuamine, injected into animals in the form of the water-soluble sulfate, does not excite the central nervous system of unanesthetized animals, may act as an analeptic to the respiratory system of some anesthetized animals but not of others and has variable effects on the restoration of the conjunctival and righting reflexes of anesthetized animals. The difference between the results obtained with anesthetized animals, on the one hand, and unanesthetized animals, on the other, may be true or may be due to differences in the method of estimating excitation in the anesthetized and unanesthetized animal. An excitant of the central nervous system, when administered to unanesthetized animals, ordinarily increases physical activity, and one would expect a goodly part of this increase to be registered on the timer of the activity wheel. This would not be the case if excitation produced convulsive or subconvulsive states, because the absence of coordinated limb movements would fail to turn the activity wheel. None of the animals given tuamine sulfate were convulsed or showed evidence of a subconvulsive condition, such as twitchings. Yet tuamine did not augment the physical activity of these unanesthetized animals, and it would seem reasonable to con-

clude that this indicated true absence of excitation of the central nervous system.

The evidence of excitation of the central nervous system in anesthetized animals was not consistent from species to species, from test to test, or even from dose to dose in the same species. When excitation did occur, for the most part it was with doses of tuamine above the thera-

TABLE 4.—*The Effect of Tuamine Sulfate Injected Intramuscularly on the Conjunctival and Righting Reflexes of Animals Anesthetized with Pentobarbital Sodium*

Dose of Tuamine Sulfate, Mg. per Kg.	Conjunctival Reflex, Minutes Absent	Righting Reflex, Minutes Absent
100 Albino Rats Given 40 Mg. of Pentobarbital Sodium per Kilogram		
0.0	63	91
1.0	59	97
2.0	57	106
5.0	53	113
10.0	41	104
50 Guinea Pigs Given 30 Mg. of Pentobarbital Sodium per Kilogram*		
0.0	64	121
1.5	52	109
3.0	48	106
7.5	51	101
15.0	54	104
50 White Mice Given 100 Mg. of Pentobarbital Sodium per Kilogram		
0.0	79	101
1.2	80	102
2.4	72	102
6.0	79	99
12.0	92	118
25 Rabbits Given 40 Mg. of Pentobarbital Sodium per Kilogram		
0.0	78	123
1.0	71	138
2.0	69	109
5.0	89	132
10.0	77	116
10 Cats Given 35 Mg. of Pentobarbital Sodium per Kilogram		
0.0	122	
1.0	75	
2.0	89	
5.0	80	
10.0	58	

* In guinea pigs, the corneal reflex and restoration of head movements were used in place of the conjunctival and righting reflexes respectively.

peutic level. In general, when excitation did occur, it was not great. Nevertheless, one must accept the fact that there was some evidence of excitation of the central nervous system in anesthetized animals, and hence it is difficult to predict what might occur in human beings from absorption of large doses of tuamine. The variable occurrence of excitation of the central nervous system again raises the question as to just what the mechanism of such a reaction is. Superficially, there would not

seem to be any difficulty involved in answering this question, but on deeper inquiry the problem is seen to be more complex. One need only recall the apparent excitation produced in human beings by not too large doses of alcohol or of ether or of nitrous oxide—all drugs which are classified as depressants of the central nervous system—or variations in the response of anesthetized and unanesthetized animals to drugs categorized as stimulants, such as nikethamide, to realize that an apparent net excitation may be due to complex reactions in the central nervous system, reactions which are as yet imperfectly understood.

SUMMARY

A drawback to the use of certain drugs, such as inhalers containing amphetamine, in the local therapy of nasal congestion, allergic rhinitis, catarrhal rhinitis and allied conditions, is the cerebral excitement which they produce when used in excessive doses. In recent years, tuamine (2-aminoheptane) has been introduced as a volatile decongestive agent which may be used in the form of an inhaler. Experiments were performed on approximately 2,000 animals, including white mice, albino rats, guinea pigs, rabbits and cats, in an effort to ascertain whether tuamine has similar excitant properties. The activity of unanesthetized albino rats, as registered in activity wheels, was not increased by injections of tuamine sulfate in doses up to one fifth the LD_{50} dose. In some species, tuamine, usually in large doses, showed some evidence of respiratory analepsis and excitation of the conjunctival reflex but not of the righting reflex in anesthetized animals. In most anesthetized animals there was no evidence of cerebral excitation. It may be concluded that tuamine in therapeutic doses, and even in doses somewhat above the therapeutic level, has little or no excitant effect on the central nervous system.

PENICILLIN IN THE FIELD OF OTOLARYNGOLOGY

Clinical and Bacteriologic Studies with Special Reference to Topical Applications

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A NUMBER of otolaryngologic cases in which penicillin was injected intramuscularly and applied topically were followed by me over a period of one year, from February 1944 to February 1945.

Much has been written recently in the literature about penicillin, but little has been said regarding the topical application of the agent in otolaryngologic cases or of the bacteriologic aspects of these cases in relation to the clinical work. Penicillin has been found to be effective in the presence of pus, peptones, tissue autolysates and other substances that are inhibitory of sulfonamide compounds.[1]

Penicillin is essentially nontoxic, and the toxic reactions attributed to it were apparently due to toxic impurities rather than to penicillin.[2]

Lierle and Evers[3] have shown that penicillin has practically no irritating effect on the cilia of the nasal mucosa, even when the concentration of penicillin is as high as 5,000 Oxford units per cubic centimeter of isotonic solution of sodium chloride, which is a much higher concentration than any used in this series of cases.

On the basis of the results in a case of osteitis of the left antrum, which was the first case in which pure penicillin was used locally in the nose at the Massachusetts General Hospital, it appeared that penicillin distributed throughout the nose would be a good thing. It occurred to me that penicillin should be effective in the respiratory tract because of the anatomic structure and the accessibility of its surfaces for local application. I decided, therefore, to make studies on the antibacterial and the local action of penicillin, the first of which was on penicillin as an antibacterial agent. Fifty cases in which penicillin was administered were selected and followed.

MATERIALS AND METHOD

All of the bacteriologic work except in 4 cases was done in the bacteriology laboratory of the Massachusetts Eye and Ear Infirmary.

From the Department of Otolaryngology, Massachusetts Eye and Ear Infirmary.

1. Hobby, G. L.; Meyer, K., and Chaffee, E.: Proc. Soc. Exper. Biol. & Med. **50**:281 (June) 1942.

2. Lyons, C.: Penicillin Therapy of Surgical Infections in the U. S. Army, J. A. M. A. **123**:1007 (Dec. 18) 1943.

3. Lierle, D. M., and Evers, L. B.: Laryngoscope **54**:176 (April) 1944.

The remainder of the bacteriologic examination was carried out at the laboratories of the Massachusetts General Hospital and the Deaconess Hospital and at the Thorndike Memorial Laboratory at the Boston City Hospital.

The clinical material utilized in this paper was derived chiefly from private patients.

In all the cases, cultures were made of material obtained from the ear, the nose or the throat; that is, from one, two or all of these areas. The material from the ear, the nose and the nasopharynx was taken with a special technic, by flaming an ordinary ear speculum and inserting it in the external auditory canal or some distance into the nasal vestibule so that any secondary organisms inhabiting these areas would not contaminate the culture of the pathogens. The material was taken with a sterile swab especially made to go easily through an

TABLE I—*Organisms Isolated*

1.	Coagulase-positive hemolytic Staphylococcus aureus
2.	Coagulase-negative hemolytic Staph. aureus
3.	Hemolytic Staph. aureus, not coagulase tested
4.	All other types of Staph. aureus
5.	Coagulase-positive hemolytic Staphylococcus albus
6.	Coagulase-negative hemolytic Staph. albus
7.	Coagulase-positive nonhemolytic Staph. albus
8.	Coagulase-negative nonhemolytic Staph. albus
9.	Alpha hemolytic streptococcus
10.	Beta hemolytic streptococcus
11.	Beta hemolytic streptococcus, not group A, B or C
12.	Beta hemolytic streptococcus, group A, virulent
13.	Microaerophilic beta hemolytic streptococcus
14.	Microaerophilic beta hemolytic streptococcus, group A, virulent
15.	Nonhemolytic streptococcus
16.	Anaerobic putrefactive nonhemolytic streptococcus
17.	Pneumococcus, type III
18.	Pneumococcus, type IV
19.	Pneumococcus, type X
20.	Pneumococcus, type XIV
21.	Other pneumococci—not typed
22.	Gram-negative bacillus (Klebsiella group)
23.	Bacillus pyocyaneus
24.	Haemophilus influenzae
25.	Escherichia coli
26.	Bacillus subtilis
27.	Bacillus proteus
28.	Friedländer's bacillus
29.	Neisseria catarrhalis
30.	Diphtheroids

aural speculum or else with a sterile aspirating tip of small caliber joined to a sterile glass connecting tube, in which case the material was put in a sterile container and sent to the laboratory. Here it was washed out of the glass tube with sterile isotonic solution of sodium chloride and grown both aerobically and anaerobically on blood agar plates and meat infusion broth.

As some organisms are slow in growing and many pathogenic bacteria are missed, with the cultures reported as showing "no growth" because these bacteria are anaerobic and do not show up when cultured only aerobically, many organisms were reported which would not have been found otherwise.

In the 50 cases 30 organisms were recovered, of which approximately two thirds were classed as staphylococci, streptococci or pneumococci. The organisms are listed in table 1.

The diagnoses of the cases in which penicillin was used are given in table 2. As there are only 1 or 2 cases with each diagnosis, it is realized that no final

conclusions can be drawn as to the ultimate value of penicillin for any of the conditions named but one can simply report just what occurred when penicillin was used in these cases. Cultures were made frequently in each instance (e. g., daily or nearly so if the patient was hospitalized), and the patient was followed with clinical examinations.

The bacteriologist at the Massachusetts Eye and Ear Infirmary supplied all the penicillin except that used intramuscularly, which was obtained from the various hospitals to which the patients were admitted.

Crude penicillin has been produced in the bacteriologic laboratory of the Massachusetts Eye and Ear Infirmary since February 1944. The strain used was one of the original Fleming strains of Penicillium notatum and was obtained from the National Type Collection, Washington, D. C. The preparation used is suitable

TABLE 2.—*Diagnoses of Cases in Which Penicillin Was Used*

	Cases
Acute pharyngitis	1
Subacute pharyngitis	3
Chronic pharyngitis	1
Acute nasopharyngitis	2
Subacute nasopharyngitis	3
Chronic nasopharyngitis	2
Subacute rhinitis	1
Chronic rhinitis	4
Subacute rhinitis and nasopharyngitis	3
Chronic rhinitis and pharyngitis	1
Acute sinusitis	1
Subacute sinusitis	1
Chronic sinusitis	2
Chronic sinusitis and rhinitis	1
Pansinusitis	1
Acute tonsillitis	1
Atrophic rhinitis	2
Laryngospasm and tracheitis	1
Asthma and vasomotor rhinitis	4
Asthma with vasomotor rhinitis and sinusitis	3
Vasomotor rhinitis and sinusitis	2
Vasomotor rhinitis	2
Acute otitis media	1
Chronic otitis media	1
Chronic otitis media with an acute exacerbation	1
Postoperative radical cavity with chronic otitis media	2
Bilateral chronic secretory otitis media	1
Secondary serous labyrinthitis	1
Osteitis of left antrum	1
Osteomyelitis of mandible	1

for topical application only. It has a concentration of 35 to 50 units of the agent per cubic centimeter.. It was used in 13 cases in this series. In 6 of these cases a change was made to pure penicillin when this became available. The pure penicillin referred to in this paper as being used topically was pure commercial penicillin for use in vivo. It is fresh daily and is available to the staff of the Massachusetts Eye and Ear Infirmary in the concentration of 250 Oxford units per cubic centimeter or occasionally 500 to 1,000 Oxford units per cubic centimeter. Pure penicillin was administered in 38 cases in this series.

Both of the preparations of penicillin were administered topically as a spray or as drops to be used every two hours. The penicillin was issued to the patient with instructions to keep it refrigerated. Intramuscular injections of penicillin were given in 9 cases.

OBSERVATIONS

The first case for which we were able to obtain penicillin before it was released to the hospitals to be distributed was a case of osteitis of the left antrum.

The patient had undergone radical antrotomy of the left side four times since 1922, at the hands of well known otolaryngologists in different cities, with no subsequent relief of her symptoms. Also, the infraorbital nerve and the temporal artery had been sectioned on the left side, a tear duct operated on by an ophthalmologist and two operations performed by oral surgeons. She finally was seen in consultation by Dr. Wilder Penfield, of Montreal, Canada, who advised that the antral infection be cleared up if possible. (Section of the fifth cranial nerve was done later.)

The patient was admitted to the Baker Memorial Hospital, where 500,000 units of penicillin was administered intravenously, intramuscularly, and topically in the nose. The organism found on culturing pus of the left antrum was a coagulase-positive hemolytic Staph. aureus. The first day 40,000 units of penicillin was administered intravenously, and thereafter 80,000 to 35,000 units was given intramuscularly daily for six days. Then 4,000 units was applied topically daily through the nose directly into the involved antrum for fifteen days. In the latter therapy the sodium salt of penicillin dissolved in saline solution to a strength of 250 units per cubic centimeter was used as nose drops every three hours.

There was a large opening from the nose into the antrum, as a large part of the lateral nasoantral wall had been removed in previous operations. The penicillin solution was easily instilled into the antrum.

With intravenous and intramuscular penicillin therapy there was a sharp diminution in the abundance of organisms in the cultures of material obtained from the left antrum. Only a scanty growth was obtained in six cultures and a moderate growth in one culture, the latter in about the midportion of the treatment. When local application of penicillin was started and other penicillin treatment stopped, a sterile culture was obtained the first day. The culture made on the third day was also sterile. A slight growth was obtained in the next three cultures and then, in the subsequent culture, an abundant growth in spite of continued use of penicillin solution as nose drops. Four additional cultures at intervals of twenty-four hours were sterile, after which all penicillin treatment was given up. The next two daily cultures made of material from the nose were sterile, but on the third, fourth and fifth days after cessation of treatment there was an abundant growth of a hemolytic Staph. aureus. Then, over a period of ten days, six cultures were made, all of which were sterile. Three days later an abundant growth of the same organism was found in the culture, with sterile cultures again for five days afterward. Further cultures were made three and eleven days later and showed abundant growths of the organism. The conclusion from the foregoing observations was that it was possible in this case to sterilize the antrum temporarily by the topical use of a solution of pure penicillin. It was surprising that the antrum showed, apparently, a tendency to resist reinfection for an appreciable period after all local treatment had been stopped.

It was of great importance to obtain complete sterilization of the antrum in this particular patient in order to observe the presence or the absence of pain in relation to infection. If the antrum could be sterilized adequately and there was persistence of pain in spite of such treatment, presumptive evidence would be had that further treatment should be in the realm of neurosurgery,

and it was for this reason that Dr. Penfield had particularly recommended attempts at such sterilization. Because the patient was naturally reluctant to believe that the pain was not necessarily caused by the infection of the antrum, it was decided to give additional treatment with penicillin intramuscularly. It was hoped that this therapy with a more adequate dosage than that originally used might produce the desired results. Therefore, an additional 1,000,000 units of penicillin were given intramuscularly at the rate of 100,000 units daily without any being applied topically in the nose. The aim of the treatment was to rule out the possiblility that real sterilization of the antrum had not occurred during the first period of treatment, the organisms having been merely inhibited by the penicillin present in the nose when material was taken for culture. It was for this reason that no penicillin was put in the nose in the second period of treatment, all treatment being by intramuscular injection.

A complete absence of gram-positive organisms in cultures of material from the left antrum was observed after the first day. Cultures were made every twenty-four hours for ten days. Several of the cultures yielded E. coli, an organism which was regarded as unrelated to the antral disease. The patient decided, however, after the foregoing observations to undergo a neurosurgical operation for the relief of the facial pain.

Of the 13 cases in which crude penicillin was used, there was only 1 in which a sterile culture was obtained by such treatment. The patient had asthma, vasomotor rhinitis, chronic sinusitis and subacute rhinitis. The primary culture, made of material taken from the nose before the treatment was begun, was positive for the alpha hemolytic streptococcus. Crude penicillin, 50 units per cubic centimeter, was given in the form of a nasal spray, and after one week of therapy a culture of material taken from the nose showed no growth. Cultures taken after the second and third weeks of therapy were likewise sterile, but at the end of the fourth week a secondary invading organism appeared: a coagulase-negative nonhemolytic Staph. albus.

In a case of chronic suppurative otitis media the culture showed both a microaerophilic beta hemolytic streptococcus and B. proteus. After one week of therapy the culture showed B. subtilis, two weeks later B. pyocyaneus and three weeks later E. coli. Weekly cultures then showed B. proteus again.

Crude penicillin was administered in a case of acute pharyngitis in which the primary organism was a coagulase-positive hemolytic Staph. aureus. After four weeks of therapy, there still remained the original organism and, in addition, there was a beta hemolytic streptococcus, not of group A, B or C.

In a culture of material taken from the nose of a child with chronic rhinitis, four different organisms were recovered: (1) a pneumococcus, (2) a coagulase-positive hemolytic Staph. aureus, (3) a gram-negative bacillus (Klebsiella group) and (4) an alpha hemolytic streptococcus. After crude penicillin (50 units per cubic centimeter) had been administered for one week, the same organisms were recovered except that

the pneumococcus was not present. Two weeks later there was only the coagulase-positive hemolytic Staph. aureus.

In 38 cases in this series pure penicillin was administered locally. The strength of the solution used in the majority of cases was 250 units per cubic centimeter, and in several cases, 500 to 1,000 units per cubic centimeter. In only 6 cases did the treated areas become sterile. In 14 cases secondary invading organisms were present; in 7, the original organisms. In 8 cases only the primary culture was made. One case in which there were five organisms on the first culture (one of which was E. coli) was free of all organisms except E. coli, which remained (as would be expected) in the culture after six weeks of therapy. This was in a case of atrophic rhinitis. In all of these cases penicillin was topically applied for a period varying from one week to four months.

The average duration of therapy was four weeks.

The organisms identified in this series of cases were gram-positive cocci (staphylococci, pneumococci or streptococci) in about two thirds of the cases. Since it is well known that these organisms are usually penicillin sensitive, tests for penicillin sensitivity were omitted except in a few cases. It may be that various strains of organisms had marked differences in susceptibility to penicillin and I hope to repeat the bacteriologic work subsequently to determine this point in detail. Certainly more detailed bacteriologic work should be carried out to ascertain which strains of staphylococci, pneumococci and streptococci are somewhat resistant to the action of penicillin and yet may yield in the presence of adequate local use. Furthermore, the factors in topical application which cause normally susceptible strains to become resistant must be studied.

In a case of atrophic rhinitis, in which a middle ear discharged into the cavity left after a radical mastoidectomy, and in which topical applications of crude penicillin were made for eight weeks and pure penicillin for seven weeks, totaling fifteen weeks, E. coli was present in every culture during the period of therapy. The original organisms were a pneumococcus (not type III), a coagulase-positive hemolytic Staph. aureus, Friedländer's bacillus and E. coli in the nose and a coagulase-positive hemolytic Staph. aureus and E. coli in the ear. At the end of seven weeks of local penicillin treatment E. coli was still present in the nose, but the ear was dry. At the end of the fifteenth week there were a pneumococcus and E. coli again in the nose and a coagulase-negative hemolytic Staph. albus in the ear.

In another case of atrophic rhinitis, already mentioned, E. coli was the only organism isolated after pure penicillin had been administered topically for six weeks.

In a case of Ménière's syndrome in which a chronic infection of the nasopharynx developed, a coagulase-negative Staph. albus was isolated.

One week later, despite the penicillin administered locally, there was also an alpha hemolytic streptococcus. Six weeks later with continuance of the local application of penicillin there was no growth, and cultures made at weekly intervals had shown no growth for four weeks when the original organism reappeared.

In 9 cases of this series of 50, penicillin was administered intramuscularly. In 2 of these cases crude penicillin had been given formerly and in 2 pure penicillin had been administered locally.

In 1 case of subacute rhinitis and chronic nasopharyngitis and asthma in which the organism isolated from the nasopharynx was a coagulase-negative hemolytic Staph. aureus, a million units of penicillin was injected intramuscularly and one negative culture was obtained after a week. Cultures taken one week after the penicillin therapy was omitted showed again the coagulase-negative hemolytic Staph. aureus.

A patient who had osteomyelitis of the mandible had an incision made in order that the causative organism might be isolated and biopsy evidence of the pathologic process provided. The diagnosis was established, and a coagulase-negative hemolytic Staph. aureus was recovered. It is of great interest that on intramuscular administration of 800,000 units of penicillin at the rate of 100,000 units daily the osteomyelitic process, which extended along the anterior portion of the body of the mandible for about 10 cm., disappeared completely both clinically and roentgenographically.

In a case of bilateral acute suppurative otitis media with an abundant growth of Pneumococcus type III in cultures of material from both ears, the ears became dry after 152,000 units of penicillin had been administered intramuscularly over a period of four days.

In a case of acute exacerbation of chronic suppurative otitis media with a coagulase-negative hemolytic Staph. aureus and a beta hemolytic streptococcus, group A virulent, a change was made from sulfadiazine therapy after five days to intramuscular injections of penicillin, as the discharge from the ear was unabated. The original organisms disappeared, and a coagulase-negative hemolytic Staph. albus appeared. The ear became dry within a week. It was interesting to note that while the patient was receiving 96,000 units daily she complained of a sore throat although there was no evidence of inflammation.

A woman 38 years old had recurrent pharyngitis and infections of the throat for two years, first at intervals of four months and then as frequently as every three weeks, incapacitating her for work. Cultures of material from the nose and the throat showed a coagulase-positive hemolytic Staph. aureus. Pure penicillin was administered locally. Five weeks from the time that the first culture was made there was no growth from material taken from the nose but the organism persisted in the

throat. There continued to be recurrent infections of the upper respiratory tract. Later the patient was hospitalized for treatment designed to sterilize the upper respiratory tract. During the hospitalization, repeated cultures were made of material from the oropharynx and the nasal cavities, which showed Staph. aureus and Streptococcus viridans. An adequate dosage of sulfadiazine was used for one week, with positive cultures persisting. Then the patient was given 1,000,000 units of penicillin intramuscularly (100,000 units daily). The nose and the throat were temporarily freed from the infecting organisms. A deviated septum was then corrected, and tonsillar remnants were excised. The patient was able to return to work and worked consistently.

A diabetic patient with chronic rhinitis and secondary pharyngitis had cultures showing a coagulase-negative Staph. albus and B. subtilis. She was given a million units of penicillin intramuscularly. The coagulase-negative Staph. albus disappeared, but B. subtilis remained in the cultures for four weeks.

A woman with cervical arthritis and chronic pharyngitis had four organisms in the primary culture: a microaerophilic beta hemolytic streptococcus, an alpha hemolytic streptococcus, H. influenzae and B. pyocyaneus. She was given 100,000 units of penicillin intramuscularly daily for seven days. After one week of therapy the cultures showed the alpha hemolytic streptococcus and the beta hemolytic streptococcus. The beta hemolytic streptococcus persisted in the cultures during the next three weeks, the alpha hemolytic streptococcus remained for seven weeks after penicillin therapy was stopped. A culture taken at the end of seven weeks had a coagulase-positive hemolytic Staph. aureus, B. pyocyaneus and the alpha hemolytic streptococcus; however, the patient was clinically improved.

COMMENT

In evaluating the antibacterial action of penicillin topically applied in the ear, the nose and the throat, it would seem from the culture series reported here that penicillin is not an effective bactericidal agent in this tract. In only a small percentage of the cases studied did the areas treated become sterile, and in an even smaller percentage did they remain sterile for any appreciable time, as has been shown in the foregoing pages.

The action could better be described as bacteriostatic and bacteriolytic. Penicillin is known to be bacteriostatic in small quantities and bactericidal in large quantities. Hobby, Meyer and Chaffee [1] stated that penicillin is most effective on actively multiplying organisms. They suggested "that penicillin prevents the assimilation of growth factors necessary for cell division."

The clinical results reported in the foregoing pages have shown that penicillin does not need to be bactericidal in its action to secure good

clinical results, which is in accordance with Queen,[4] who stated that the mechanisms of host resistance when supplemented with bacteriostatic doses of penicillin "usually suffice to accomplish the destruction of the penicillin-sensitive pathogens."

Florey and his co-workers [5] found that the effect exerted by penicillin differs from that exerted by the sulfonamide drugs on staphylococci and streptococci in that it is influenced only to a minor degree by the number of bacteria to be inhibited.

The failure of penicillin as a bactericidal agent has been explained by Biggers [6] with his theory of "persisters," i. e., the theory that the failure to sterilize is due to small numbers of survivors or persisters which are insensitive to penicillin because they are in a temporary nondividing state and that penicillin is lethal only to bacteria about to divide. He suggested that continued administration of penicillin will check the persisters and that a "treatment schedule might be worked out with periods of intensive treatment alternating with periods of rest during which bacteria in the persister state will divide and be killed when penicillin is again administered."

Todd [7] confirmed this and added that bacteriostasis, bactericidal action and bacteriolysis may be different stages of a single process proceeding in that order. He stated that "there is at present no evidence whether one or more factors are involved in the bacteriostatic, bactericidial and bacteriolytic effects of penicillin since the method of its action is unknown." He suggested that the effectiveness of penicillin depends on the fact that young cultures in the stage of multiplication are more susceptible to the bacteriolytic reaction of penicillin than older cultures.

It has been demonstrated that sensitive organisms may become resistant to penicillin and that certain organisms may destroy penicillin. Penicillinase, an enzyme believed to be produced by certain bacteria, may destroy the bacteriostatic property of penicillin. These organisms include gram-negative bacilli and many aerobic gram-positive space-forming bacilli. Among the bacilli are B. anthracis, B. coli, Pseudomonas (certain strains) and B. cereus.

The rate of absorption of penicillin depends on the supply of circulatory channels, the route of administration and the form in which the drug is administered. It is excreted rapidly following intravenous administration.[8] Negligible amounts are detected in the blood stream after three to

4. Queen, F. B.: Rocky Mountain M. J. **41**:721 (Oct.) 1944.

5. Abraham, E. P.; Chain, F.; Fletcher, C. C.; Florey, H. H.; Gardner, A. D.; Heatley, N. G., and Jennings, M. A.: Lancet **2**:177 (Aug. 16) 1941.

6. Biggers, J. W.: Lancet **2**:497 (Oct. 14) 1944.

7. Todd, E. W.: Lancet **1**:74 (Jan. 20) 1945.

8. Herrell, W. E.; Heilman, D. H., and Williams, H. L.: Proc. Staff Meet., Mayo Clin. **17**:609 (Dec. 30) 1942.

four hours. The period during which penicillin topically administered in the nose remains in the nasal cavity is short owing to the rapid excretory action of the ciliated epithelium. This factor partly explains the failure of penicillin to sterilize the respiratory tract; the drug is not left in situ long enough to have a beneficial action on the residual organisms.

As was pointed out, one of the best results obtained in this study was in the case of osteitis of the antrum in which the penicillin was administered directly into the antrum and remained trapped there for a longer period. One might deduce that penicillin would be of value with the Proetz displacement method of sinus treatment.

Penicillin administered locally does not prevent the invasion of secondary organisms.

247 Commonwealth Avenue.

DIPLACUSIS AND ACUITY OF HEARING

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WHILE a graduate student and National Research Fellow in Physics, from 1920 to 1923, at the University of Chicago, I had the opportunity to cooperate with Dr. J. Gordon Wilson of Northwestern University Medical School in studying various types of deafness. Many of our studies were presented to physicians and physical therapeutists. I have maintained my interest in diseases of the ear and their effects on hearing during the intervening years. The subject of diplacusis is one rarely met with and little discussed. Dr. Wilson and I reported on 1 case.[1] It is felt that the following discussion involving my case of diplacusis may prove of interest to the otologist and add to our early statement of 1923. Dr. R. S. Yancey of Dallas has been interested in the case and has made the medical treatments involved.

REPORT OF A CASE

History.—On Dec. 5, 1944, I was visiting one of the petroleum exploration field crews of the Magnolia Petroleum Company in West Texas. In some phases of the work dynamite is detonated in a shot hole, some 50 to 100 feet (15 to 30 meters) deep, with a column of water to the surface to serve as tamping. In this particular instance no water was on the charge of dynamite, which was only some 20 feet (6.1 meters) below the surface. Not knowing this, I was standing about 20 feet away from the shot hole. On detonation of the charge, the explosive wave generated caused no pain in the ears but did produce a distinctly noticeable change in the hearing of the right ear. No effect was noted in the left ear. The effects may prove interesting to the medical profession, since one of them involved a temporary case of diplacusis.

Medical assistance was not solicited from Dr. Yancey until about two weeks after the explosion. By this time four effects had been generally noted: 1. There was a loss in acuity of hearing of the right ear. Previously the right ear had had better hearing than the left one. Now the hearing of the right ear was substantially depressed. 2. A strong effect of resonance was noted in the right ear. 3. Sounds which one hears during the course of a day's work were definitely of a higher pitch in the right ear than in the left one. 4. A high pitched tinnitus, of frequencies in the region of 8,000 to 10,000 cycles, was continuously present in both ears. These observations will be elaborated on, briefly, in the order stated.

From the Field Research Department, Magnolia Petroleum Company.

1. Minton, J. P., and Wilson, J. G.: Physical Measurements of Minimum Audibility, J. Laryng. & Otol. **38**:405-418 (Aug.) 1923.

Sensitivity of Hearing.—A vacuum tube oscillator circuit, equivalent to the audiometer, was set up, and the curves illustrated in chart 1 were obtained over a period of three months. The curves show the depressed acuity of hearing of the right ear in decibels compared with normal hearing for people in the general age bracket of 25 years. For comparison, similar data taken by me on this ear twenty-five years ago are included.

Chart 1 shows that the higher frequency characteristics present some twenty-five years ago still exist today but with larger depression in the sensitivity. The medical treatments received from Dr. Yancey subsequent to the explosion produced little change in the acuity for the higher frequency register. There was definite improvement in the lower frequency region, however. The initial, approx-

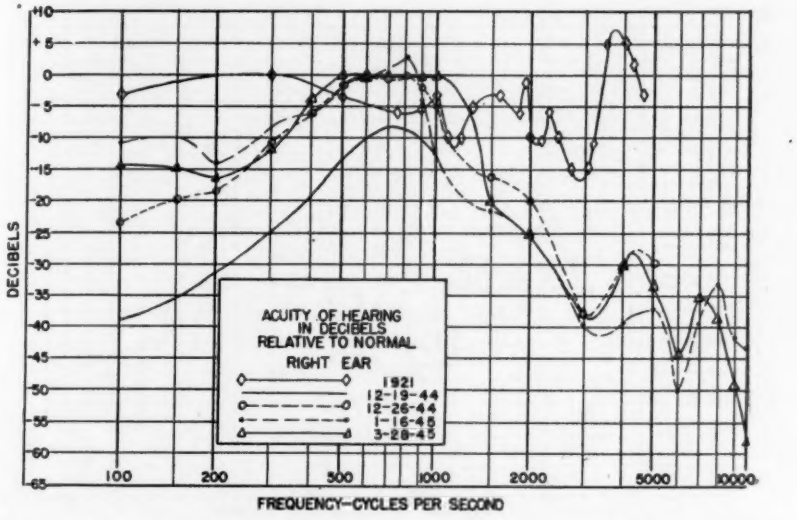

Chart 1.—Acuity of hearing of right ear relative to normal after accident in 1944 and about twenty-five years earlier.

imate curve for December 19 is based on only a few observations, and the points are not shown. The other curves were accurately determined, as indicated by the points shown.

In chart 2 are shown curves for the left ear taken during this three month period. There was little, if any, observable change in the left ear with respect to acuity of hearing during the period of Dr. Yancey's treatments. It is interesting to note how well the various curves are duplicated, even to the smaller variations, over a period of time. This applies to the curves for the two ears.

Diplacusis.—Cases have been reported in which different tones have been perceived in the two ears when the source of sound was a single pure tone. No satisfactory explanation of this phenomenon has come to my attention. Likewise, no discussion of any particular case has come to my attention. For these reasons the present discussion may be of interest.

Attention was first directed to the phenomenon during Dr. Yancey's tests with the 256 cycle tuning fork for air and bone conduction, the latter of which was not observable at any time in either ear. The left ear perceived the clear single tone of the fork, while the right ear perceived no pure single tone, but a sound,

better described as a "noise," of a pitch range definitely higher than the tone of the fork. The 256 cycle fundamental was not heard in the right ear during the early period of these observations.

The audiometric tests were made to secure more data on this effect, which appeared to me to be an example of diplacusis even though two pure tones of different pitch were not heard by the two ears from the single source of sound.

The first audiometric tests extended up to 5000 cycles. Throughout this whole range, pure tones were heard by the left ear. In chart 1 the curves, with the exception of the early approximate curve, show the right ear to possess normal hearing from 500 to 1000 cycles. In this range the right ear heard pure tones, identical with the tones heard by the left ear. From 100 up to 400 cycles, the

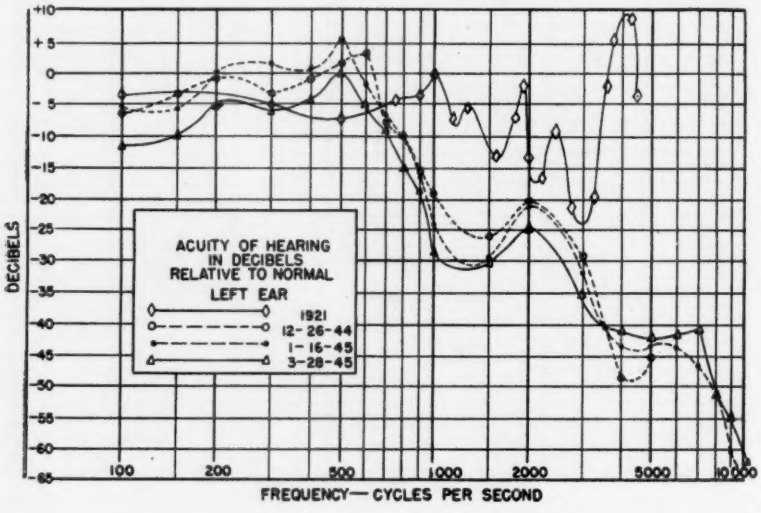

Chart 2.—Acuity of hearing of left ear relative to normal after accident in 1944 and about twenty-five years earlier.

right ear (on December 26) heard noise the frequencies of which were scattered randomly at pitches above the fundamental, as heard by the left ear. These noises of higher pitch were not of harmonic frequencies of the fundamental. When an attempt was made to hear the fundamentals through the noise, it was quite obvious that the acuity of hearing of the right ear for the fundamental would have been far depressed below the threshold for the noise. Thus, over the range of 100 to 400 cycles, the curves for the right ear are really threshold curves for the noise.

On December 26 these effects were observed closely, and for this purpose the sound source from the audiometer was increased in intensity, to enable the observations to be noted more definitely. However, the effects existed down to the threshold values.

In the higher frequency region, the right ear continued to hear the fundamental (as did the left ear) only up to 2550 cycles. However, from 2550 to about 4000 cycles the right ear heard nothing but noise, the frequencies of which were scattered randomly in this range. The general pitch level, of course, continued above that of the pure tone heard by the left ear, an increasing difference being

observed as the region of 4000 cycles was approached, where both ears again heard the single pure tone, up to 5000 cycles, the point at which the tests ended.

At 2550 cycles, where the pure tone in the right ear began to change over into noise, a beat frequency was observed with head phones in each ear. This beat frequency was easily made zero by lowering the oscillator frequency slightly. By raising the frequency the beats could be counted, but they were not distinguishable with increasing frequency, and the sound faded into the noise region perhaps at 2575 cycles.

Later tests extended up to 10000 cycles and beyond 11500 cycles neither ear was able to perceive the tones of the osciliator. The tests made on Jan. 16, 1945 showed that the effects described had disappeared for the right ear at the higher frequencies. This ear heard nothing but pure tones from 500 to 11000 cycles. It heard the pure fundamental tones from 150 to 500 cycles, with the noise (of which I have spoken) superimposed in the background with not much disturbance. Below 150 cycles only noise was heard. However, on January 29 some observations showed the noise effect in the lower frequency region more pronounced. Nevertheless, the fundamental could be distinguished at 200 and 300 cycles if the tone level was increased 20 and 15 decibels, respectively, above the threshold for the noise at these two frequencies.

Diplacusis was searched for on February 2, in an effort to determine whether it might exist at frequencies other than those already noted. It was observed, but only slightly, in the region of 650 to 750 cycles. Zero beat could not be produced, but beats of the order of 5 to 10, perhaps, could be detected. They were not steady, however, such as those already described for 2550 cycles. In this region, on this date, there was a superimposed noise in the background, much like that in the lower frequency region for the right ear.

These effects were subjective in the right ear. There were no obvious harmonic overtones, such as one would expect from the oscillator and the ear if nonlinear distortion only were present. This type of distortion, it is believed, was not present. For the oscillator and ear phones, it was believed that any such overtones generated would be perhaps 40 decibels below the fundamental.

The tests made on March 28 concluded these observations. On this date the tests showed the right ear to hear pure tones from the region of 150 to 10,000 cycles. The 100 cycle tone was somewhat impure, but it was believed that the ear had reverted to its condition prior to the explosion.

COMMENT

One might reason that the high-pitched noise heard in the right ear was due to distortion of large magnitude, and that the right ear had better acuity than did the left for tones in the region of 600 to 2000 cycles. However, it is believed as has been pointed out, that this is not the case for the audiometer and its auxiliary equipment. The left ear was not conscious of any distortion present at any frequency, and the harmonics, if present, would be quite evident in the right ear because of the large differences of frequencies between the fundamental and the harmonic overtones. Harmonic distortion of this sort is easily distinguishable as such, if present.

This view is strengthened by the fact that the most readily detectable diplacusis was in the region of 2500 cycles, and harmonic distortion

would show up at 5000 cycles, above which the acuity of hearing was decreasing rather than increasing.

It is to the point, then, to attempt to arrive at some opinions as to the physical cause of the disturbances which have been reported. If the basilar membrane is responsible, as many authorities believe, for the ability of the ear to distinguish one pure tone from another by the shift in position of maximum amplitude of this membrane, then both ears would have heard pure tones only, though different ones. This was not the case, however. Nevertheless, it was partly true at 2550 cycles, where the beats were heard definitely, and partly true, at times, near 650 to 750 cycles, where beats near zero were heard. On the basis of this function of the basilar membrane, there may have occurred some shift in the relative positions of this membrane in the two regions cited. The effect, if present, would account for the diplacusis, which disappeared after about three months.

However, to account for the presence of the noise, with characteristics as described, one would have to postulate some temporary damage, due to overstrain by the explosion, to the basilar membrane of the right ear. This overstrain would, then, have had to cause this membrane to be placed in such a condition that a broad range of general maximum amplitude, rather than a relatively narrow range, would result by acoustic stimulus of the single tone. This effect would have had to extend over a region of the membrane corresponding to a range of 100 to 400 cycles and of 2500 to 4000 cycles. In these ranges the acoustic stimuli would have had to produce sufficient amplitude of the membrane to excite the auditory nerves to at least their threshold stimulation on the "all or none" basis. Under such conditions, it would seem possible for a single tone to excite a series of higher, random tones subjectively in the cochlea.

It is not believed that the auditory nerves themselves could cause such effects, since it is assumed that intense sounds are recognized as intense ones for the reason that more nerves are excited rather than a limited number of nerves at greatly increased intensities.

Neither is it believed that the ear drum and auditory ossicles would be a possible source of explanation, since these are simple mechanical structures, serving to transmit pressure effects due to sound into the inner ear system.

In order to compare my case with that reported by Dr. Wilson and me some years ago and referred to in the introduction of the present paper, it will be helpful to quote our previous statement:

> In July 1921, the subject had an acute rhinitis accompanied by acute otitis media in the left ear with vertigo. For three weeks subsequent to the attack he had a pronounced diplacusis. From notes taken at this time he tells us: "The left ear perceived notes as being of different pitch from the right. Certain

notes throughout the entire musical scale seemed to sound more markedly different than others in the two ears. I was not able to determine that the intensity of the note had anything to do with the effect. The left ear seemed to perceive some notes as being of double pitch, one of the true pitch and the other slightly lower. Many notes heard by the left ear were without this characteristic, and to this ear were as pure in quality as in the good (right) ear but lower in pitch." The left ear showed calcareous deposit in the membrane anterior to the malleus. The whisper was greatly diminished. The Rinne test was positive; the Weber was not referred; the high notes, the perception of C^5 fork and of the Galton whistle, were diminished. The history and otological findings, together with the depression for all the high notes shown in the curve, suggest an internal ear involvement.

A comparison of my present observations with the observations of the patient which have been quoted show much in common. Notes heard by the two ears in my case were, over certain ranges, of different pitches. Notes in certain ranges were considerably different in the two ears, the left ear being correct, while the right ear translated the notes incorrectly. The intensity of the notes had nothing to do with the effect. The defective ear resolved the notes into higher-pitched ones. This effect is just the opposite of that in the earlier case. In the present case, whenever pure tones alone were heard by the defective ear, the tones sounded of identical pitch in the two ears. When distorted sounds of higher pitch were superimposed on the pure tones heard by my defective ear, the pure tones recognized must have been different from the true tone heard by the left ear, because of the phenomena of beats which were readily observed in the early stages of the tests.

This comparison, then, indicates that the 2 cases of diplacusis have many points of similarity. It is perhaps true that my observations are much more detailed and extend over a longer period than was true for Dr. Wilson's patient reported earlier by us. It is also interesting to note that the 1921 case extended over a three week period before this lesion of the auditory nerve disappeared.

I should add that not only was no paracusis present, but, very much to the contrary, extraneous sounds of any type proved to have a serious masking and disturbing effect on the sounds to which I desired to direct my attention. It requires a full, normal range of acuity of hearing mentally to exclude undesirable sounds from those to which one wishes to listen.

Effect of Resonance.—In the section on the history of the case reference was made to an effect of resonance in the right ear. This is readily accounted for by the shapes of the curves shown in chart 1. The acuity of hearing is essentially normal in this ear from 500 to 1000 cycles, and it is substantially depressed on either side of this "peak." Hence, the effect on general sounds would be to emphasize the frequency components in this region of maxima.

Tinnitus.—As stated previously, a high-pitched tinnitus developed in the region of 8000 cycles. At one time it became lower in frequency, perhaps in the range of 6000 cycles. However, it continued for about four months, for the most part without interruption, in the region of 8000 cycles, corresponding to the mildly hissing sound of steam. This disturbance, however, essentially disappeared during the succeeding two months.

There has been occasional tinnitus for only a few seconds at a time, at various frequencies from approximately 300 up to perhaps 3000 cycles. These particular subjective tones have always been pure tones, never a mixture of tones or noises. They would indicate, it seems, that the nerves will transmit these subjective pure tones to the brain without distortion. These same pure tinnitus tones were, at times, in the frequency range where pure audiometer tones produced only the recognition of a noise in the brain itself. Hence it would seem that the two effects are produced at different positions in the ears—tinnitus in the auditory nerves and the noise, with pure tonal stimuli, in the internal ear, excluding the nerve endings.

Audiometric Testing of Ears.—The effects described in the present paper indicate that threshold tests at various single frequencies may be at times threshold tests for subjective impure tones excited by the pure tone stimuli. Under such conditions, audiometer readings would not be for these pure tones themselves, and curves plotted from such readings would not be truly representative of the acuity of hearing at pure single frequencies, as they are presumed to be. This warning is given in view of the noise generated in certain frequency regions by pure tones and the use of these noises to determine the threshold of audibility.

Dr. J. Gordon Wilson, retired physician and professor at Northwestern University Medical School, made helpful criticisms and suggestions. Dr. R. S. Yancey, of Dallas, cooperated throughout the tests and observations reported. Dr. R. A. Millikan, California Institute of Technology, initiated, and guided in its early stages, the cooperation between Dr. Wilson and me.

LARYNGEAL TUBERCULOSIS

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ALTHOUGH there are many studies of laryngeal tuberculosis, most of these are based on clinical observations. The pathogenesis of laryngeal tuberculosis, over which there has been much controversy, cannot be studied from clinical findings alone, because organs other than the larynx must also be examined. This can be done only when the clinical findings are correlated with the pathologic studies.

In the course of autopsies by my colleagues and me, the larynx was routinely examined for gross and microscopic pathologic changes. An opportunity was thus afforded us to study the mode of development and the progression of laryngeal tuberculosis as well as its relationship to tuberculosis in other parts of the body.

INCIDENCE

During a period of five and one-half years there were 811 cases of tuberculosis which came to autopsy. Of these, 304 (37.5 per cent) showed evidence of laryngeal involvement. Although this is in accord with Lockard,[1] who found an average of 34.5 per cent in a series gathered from a large number of statistical reports, it is at great variance with Fetterolf,[2] who found 83 per cent in a series of 100 autopsies. The latter author's study, however, was based on the gross appearance alone, and many of his cases showed only an "infiltration." We have found that infiltration may be the result of chronic inflammation and not tuberculosis.

Dworetzky and Risch [3] and Myerson,[4] in their clinical studies over a period of years, noted that there has been a decrease in the incidence of laryngeal tuberculosis. This they attributed to the increasing employment of collapse therapy in the treatment of pulmonary tuberculosis.

From the Department of Pathology, Sea View Hospital.

1. Lockard, L. B.: Tuberculosis of the Nose and Throat, St. Louis, C. V. Mosby Company, 1909.

2. Fetterolf, G.: The Larynx in One Hundred Cases Dying of Pulmonary Tuberculosis, Tr. Am. Laryng. A. **36**:258-272, 1914.

3. Dworetzky, J. P., and Risch, O. C.: A Study of Five Hundred Cases of Pulmonary Tuberculosis with a Résumé Based on Twenty-Eight Years of Experience, Ann. Otol., Rhin. & Laryng. **50**:745-757 (Sept.) 1941.

4. Myerson, M. C.: Tuberculosis of the Larynx, Quart. Bull., Sea View Hosp. **4**:127-137 (Oct.) 1938; **4**:217-257 (Jan.) 1939.

Thomson [5] (1913), on a basis of autopsy studies, reported an incidence of 48 to 83 per cent, and Habersohn [6] (1905) found an incidence of 48 per cent. Our own findings also bear out the conclusion that there has been a decline in the incidence of laryngeal tuberculosis.

Much stress has been laid on the variation of the reports of the incidence of laryngeal tuberculosis. This difference is to a large degree due to the type of cases chosen for study. We have found that laryngeal tuberculosis occurs most frequently in persons who die with pulmonary tuberculosis of a duration from one to two years. Thus, a series of patients who have been under treatment for pulmonary tuberculosis for a number of years will show a much lower incidence than patients with more rapidly progressive tuberculosis. Our findings appear to contradict the view of Schuster [7] that the invasion of the larynx tends to come late in the disease.

AGE

The youngest person in our series of cases was 15 months, while the oldest was 82 years. The majority of our patients were in the age group between 20 and 39 years. Since laryngeal tuberculosis in almost every instance is secondary to chronic pulmonary tuberculosis, it is no surprise to find that the age distribution in the table is similar. This finding contradicts the view of Thomson and Negus [8] that there is a relative as well as an actual decrease in the frequency of laryngeal tuberculosis in persons below 20 years and over 50 years.

It has often been pointed out that tuberculosis of the larynx in children is rare. The reason for this lies in the fact that children usually show a primary complex or hematogenous pulmonary tuberculosis, from which no tubercle bacilli can escape to pass over the mucous membrane of the larynx. When a progressive primary complex with cavitation or chronic pulmonary tuberculosis develops, laryngeal tuberculosis is found as frequently in children as in adults. Howie,[9] in his study, found that there is an almost constant appearance of open phthisis in cases of laryngeal tuberculosis in children. Rubin and Galburt [10] made a similar observation.

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5. Thomson, S. C.: Tuberculosis of the Larynx: Its Significance to the Physician, Brit. M. J. **2**:841-844 (Nov. 8) 1924.

6. Habersohn, S. H.: The Treatment of Laryngeal Tuberculosis, J. Laryng. **20**:630-637 (Dec.) 1905.

7. Schuster, F. P.: Observations on the Larynx in the Tuberculous, Arch. Otolaryng. **25**:23-26 (Jan.) 1937.

8. Thomson, S. C., and Negus, V. E.: Diseases of the Nose and Throat, ed. 4, New York, D. Appleton-Century Company, Inc., 1937, pp. 718-744.

9. Howie, T. O.: Tuberculosis of the Larynx in Childhood, J. Laryng. & Otol. **55**:269-281 (June) 1940.

10. Rubin, H., and Galburt, S.: The Larynx of the Tuberculous Child, Arch. Otolaryng. **30**:421-428 (Sept.) 1939.

SEX

There were 208 males and 96 females with laryngeal involvement in our group of cases. This was in direct proportion of males to females found in the general autopsy series of cases of tuberculous patients during this period.

RACE

One hundred and eighty-five were Caucasians, 116 Negroes and 3 Asiatic. This is also directly proportional to the race incidence in our general autopsy series.

Comparison of Incidence of Tuberculosis of the Larynx with That in the General Autopsy Series, According to Age, Sex and Race.

Age, Years	Number	Per Cent
Tuberculosis of the Larynx		
1- 9	2	0.6
10-19	21	6.9
20-29	78	22.3
30-39	81	26.6
40-49	57	18.7
50-59	43	14.1
60-69	16	5.2
70 +	6	1.9
General Autopsy Series		
1- 9	15	1.8
10-19	61	7.5
20-29	174	21.4
30-39	200	24.5
40-49	153	18.8
50-59	125	15.4
60-69	66	8-1
70 +	6	1.9
Sex		
Tuberculosis of the Larynx		
Male	208	68.4
Female	96	31.6
General Autopsy Series	586	72.3
	225	27.7
Race		
Tuberculosis of the Larynx		
White	185	60.9
Negro	116	38.1
Asiatic	3	1.0
General Autopsy Series	487	60.0
	315	38.8
	9	1.2

ASSOCIATED TUBERCULOSIS OF THE INTESTINAL AND UPPER RESPIRATORY TRACTS

During the course of this study it became increasingly evident to us that there was a higher incidence of tracheobronchial and gastrointestinal tuberculosis in patients with laryngeal involvement than in our general autopsy series.

GASTROINTESTINAL TUBERCULOSIS

Of the 304 patients with laryngeal tuberculosis, 268 (88.1 per cent) showed evidence of intestinal tuberculosis. The incidence of intestinal

tuberculosis in our general autopsy series is 70.4 per cent. The majority of the cases (54 per cent) revealed extensive and deep-seated ulceration of the intestinal tract. In many instances the process in the intestines was farther advanced than that in the larynx, evidence of the fact that in most cases intestinal tuberculosis precedes laryngeal tuberculosis.

TRACHEOBRONCHIAL TUBERCULOSIS

There were 173 cases (56.9 per cent) of tracheobronchial tuberculosis in this group, in contrast to 30 per cent in our general autopsy series. Thomson and Negus,[8] on the other hand, found that tracheal ulceration occurred as part of tuberculous laryngitis in 10.35 per cent of the cases, while Habersohn [6] reported an incidence of 21.9 per cent. In general, when tracheobronchial tuberculosis was present, the trachea and major bronchi showed gross and microscopic changes similar to those in the larynx.

In our study of chronic pulmonary tuberculosis we have observed a close relationship between the development of tuberculosis of the intestinal and upper respiratory tracts and the duration of involvement of the lungs. The greatest number of cases of tuberculosis of the intestinal and upper respiratory tracts was those of patients who died of pulmonary tuberculosis within two years of the onset of the disease. The longer the duration of the disease, the less likely is there to be associated tuberculosis of the intestinal or upper respiratory tracts. This is true in spite of the fact that there has been a persistently positive sputum. Blumenfeld and Goebel,[11] who made similar observations, stated the belief that laryngeal tuberculosis begins about the same time as cavitation in open pulmonary tuberculosis. Of the 302 cases of chronic pulmonary tuberculosis in this series, in 65.2 per cent the duration was two years or less. This observation appears to be in contrast to the view of Schuster,[7] that invasion of the larynx comes late in the course of chronic pulmonary tuberculosis, and to that of Thomson and Negus,[8] who expressed the opinion that the frequency of laryngeal tuberculosis increases with the duration of the pulmonary disease.

Whether the failure of tuberculosis of the intestinal and upper respiratory tracts to develop is due to local immunity of the tracts to tuberculosis we cannot say. Schuster suggested that the low incidence of tuberculous laryngitis in active pulmonary tuberculosis may be attributed to a high degree of specific resistance of the tissue to clinical invasion by the tubercle bacillus in the upper respiratory tract. Another possibility is that the ulcers which develop in the early course of the

11. Blumenfeld, M., and Goebel, W.: Ueber die Kehlkopfschwindsucht bei Kindern, Ztschr. f. Laryng., Rhin., Otol. **23**:267-273, 1932.

disease may heal, leaving a scar which may be overlooked or, if found, will show no recognizable characteristics of tuberculosis, without the subsequent development of ulceration in the tract.

PATHOGENESIS

There are two main routes of infection considered to play a role in the development of laryngeal tuberculosis: (1) direct infection from the sputum in chronic pulmonary tuberculosis and (2) hematogenous infection.

DIRECT INFECTION

In all but 2 of our cases, the route of infection was direct. Proof of this mode of infection is both direct and indirect. In a large group of cases the laryngeal involvement was part of an extensive tuberculous process of the excretory tract, which included both the tracheobronchial tree and the gastrointestinal tract. It appears that the tubercle bacilli, in their passage from the lungs through expectoration and swallowing, find ready soil in these tissues.

It has often been stated that laryngeal tuberculosis is infrequent in children. Even though hematogenous disseminations in children following the development of a primary complex are frequently found in the various organs, none are observed in the larynx. However, when cavitation does develop in children and the tubercle bacilli pass over the laryngeal mucosa, tuberculous ulcers form in it with the same frequency as in adults.

If laryngeal tuberculosis were the result of hematogenous dissemination, we should encounter it fairly frequently in generalized hematogenous tuberculosis. We have not observed this in our cases, nor have we seen this in the reports in the literature.

We have found that 47 per cent of our cases of chronic pulmonary tuberculosis show hematogenous tuberculous dissemination, which is usually a terminal seeding. Either the larynxes in these cases show no tuberculous process, or, if present, the process antedates the hematogenous seedlings in the other organs.

Hematogenous infection of the larynx did occur in 2 cases in this group. In both, the involvement of the larynx was part of a generalized hematogenous dissemination from an active extrapulmonary tuberculous process. The foci in the larynxes were in the same stage of anatomic development as those in the other organs. In both cases, cavitation was absent in the lungs and the sputum contained no tubercle bacilli; thus, there was definite evidence of a hematogenous origin of laryngeal tuberculosis. In all the other cases in this group, the sequence of events was that of chronic pulmonary tuberculosis, sputum positive for tubercle bacilli and then development of laryngeal tuberculosis.

GROSS APPEARANCE

The basic lesion, like that of tuberculous processes elsewhere on mucous membranes, is the ulcer. Von Manasse[12] stressed the fact that "infiltration," which is the first stage of the tuberculous process, produces characteristic lesions in the different parts of the larynx. These swellings vary from spindle-like elevations in the vocal cords to diffuse thickening in the epiglottis. Our observations do not bear out the findings of von Manasse.

In 19 of the 304 cases in our group the tuberculous lesion was first discovered on microscopic examination made in the course of routine examination of the larynx. In none of these was there any gross evidence of ulceration, swelling or thickening of the larynx which would lead one to suspect a tuberculous process in the larynx. Elevated areas often proved to be due to edema or chronic inflammation of a nontuberculous character.

The gross appearance of the ulcer varies with its stage of development and the degree of anatomic healing present.

The early tuberculous ulcer is shallow and irregular and usually varies from 1 to 5 mm. in width. In this stage of development it is often difficult to differentiate an ulcer from an artificial denudation of the mucous membrane.

In the later stages the ulcer becomes deeper and is lined by either a yellow, a gray or a red zone. The ulcers generally have an irregular appearance except on the superior border of the true vocal cord, where they have elliptic contours. In the cases showing deep ulceration, the process may extend to the cartilage. The exposed cartilage protrudes irregularly into the lumen of the ulcer. In many of these cases the ulceration extends from the tip of the larynx to the trachea. In a number of instances the ulcerative process extends on to the trachea. It may extend on to the base of the tongue as well as into the upper portion of the trachea but rarely on to the pharynx. In the rapidly developing process numerous ulcers develop, which may occupy a large portion of the larynx. The ulcers fuse, and the intervening intact mucous membrane is thickened. The entire process gives the larynx a geographic appearance.

SITE

There is no unanimity of opinion in the literature on the sites of predilection of laryngeal tuberculosis. This may be accounted for in part by the stage of laryngeal tuberculosis in which the lesion is studied. When the process is far advanced, multiple areas are involved. Another

12. von Manasse, P.: Anatomische Untersuchungen über die Tuberkulose der oberen Luftwege, in Brauer, L., and Ulrici, H.: Die Tuberculose und ihre Grenzgebiete in Einzeldarstellungen, Berlin, Julius Springer, 1927, vol. 3, pp. 1-101.

factor is that superficial ulcers which develop in one part of the larynx early in the course of the disease may heal, and subsequently an ulcer may form in another part of the larynx. Many of the reports are clinical studies in which some of the lesions are reported as infiltrations or erosions. Only microscopic study can verify whether these are tuberculous.

The true vocal cords were most frequently involved by tuberculous ulceration (143 cases; 47.1 per cent); the false vocal cords were involved in 89 cases (29.2 per cent). Thomson and Negus,[8] Parrish [13] and Wilson [14] also observed the true vocal cords as the most frequent site of ulceration. This is rather interesting, since it has been the teaching for years that the initial lesion is in the posterior commissure. This discrepancy may be explained by the fact that the lesion described is often that of an elevation, which, according to Thomson and Negus,[8] may remain for years without any tendency toward ulceration. Such elevations may be due to chronic inflammation. The ulcers usually occur on the upper margin, more often along the posterior than the anterior region. Our findings do not substantiate the view of Dworetzky [15] that an ulcer limited to the anterior region of the vocal cord is a rare occurrence.

The epiglottis was involved in 120 cases (39.4 per cent). The process was usually that of shallow ulcerations, which varied in size from 1 mm. to 1 cm. but were usually about 5 mm. in diameter. There may be a single ulcer, or they may be so numerous that they occupy the entire surface. In cases of severe ulceration, the ulcers may fuse and the entire epiglottis may be occupied by a single ulcer. Occasionally, in the advanced stage the underlying cartilage is eroded and projects above the surface.

The laryngeal ulceration involved almost the entire surface in 53 (14.2 per cent) of our cases. In many of these there was often an extensive destruction of the vocal cords. Often the ulceration was continuous with a similar process in the trachea. Tuberculous ulceration of the base of the tongue when it was present occurred almost exclusively in these cases.

MICROSCOPIC APPEARANCE

The development and progression of the tuberculous process in the larynx are similar in most respects to those in the tracheobronchial tree and the intestinal tract.

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13. Parrish, H.: Tuberculosis of the Larynx, New York M. J. **92**:117-120 (July 16) 1910.

14. Wilson, G. E.: Aural, Oral and Laryngeal Tuberculosis, New York State J. Med. **43**:680-688 (April 1) 1943.

15. Dworetzky, J. P.: Laryngopulmonary Tuberculosis, M. Rec. **100**:57-62 (July 9) 1921.

The earliest lesions are tuberculous foci which are present in the submucosa at variable distances from the mucous membrane. Von Manasse [12] and Renderath [16] expressed the opinion that these foci develop as the result of tubercle bacilli passing through intact epithelium, through small epithelial defects or through the ducts of the mucous glands. We believe that the last method is the most frequent if not the only mode of contact infection. No one has definitely shown that tubercle bacilli may pass through an intact surface. Epithelial defects seen in the larynx at autopsy are usually artefacts which did not exist during life.

The foci are usually small, round or oval and sometimes irregular. They are composed of epithelioid and giant cells as well as fibroblasts and lympocytes. These elements are arranged concentrically, and the larger foci contain central zones of caseation. The presence of foci in the wall of the larynx does not mean that tuberculous ulceration will follow. It is only when the tuberculous foci extend to involve the overlying mucous membrane that an ulcer develops. That these foci are frequently present in the larynxes of patients with chronic pulmonary tuberculosis is seen from the study of Esch,[17] who found an incidence of 80 per cent. These were larynxes in which there was no evidence of ulceration. The mucous membrane is intact in this stage of development. Von Manasse [12] designated this phase as the stage of pure infiltration and stated that there is often a pronounced thickening of the epithelium, especially the squamous epithelium. We have found the epithelial hyperplasia only in the later phases and secondary to an advanced tuberculous process in the subepithelial connective tissue.

A tuberculous ulcer may develop in one of two ways: (1) compression atrophy of the mucous membrane by progressive enlargement of the subepithelial foci or (2) caseous necrosis of the mucous membrane.

1. In the first mode of development, the tuberculous foci beneath the mucous membrane cause a pressure atrophy of the overlying mucous membrane as they enlarge. The mucous membrane gradually thins over this area and finally disappears. Von Manasse [12] stated the belief that most of the tuberculous ulcers develop in this manner and that the epithelium as it undergoes atrophy is broken into small islets. The thinned mucous membrane overhangs the ulcer at either end. The ulcer is lined by a zone of vascular granulation tissue, and the tuberculous foci are present at the site of the defect. The area of granulation tissue extends beneath the intact mucous membrane. Fibrin and poly-

16. Renderath, E.: Die pathologisch Anatomie der Kehlkopftuberkulose, Ergebn. d. ges. Tuberk.-Forsch. **9**:143-190, 1939.

17. Esch, A.: Pathologisch-anatomische Untersuchungen über die Kehlkopftuberkulose, Ztschr. f. Hals-, Nasen- u. Ohrenh. **17**:222-234 (Jan. 31); 530-542 (March 18) 1927.

morphonuclear leukocytes exuded from the capillaries form the pyogenic membrane which lines the wall of the ulcer.

2. In the second type of development, caseous foci form in the wall of the larynx. These areas of caseation may at the onset involve the submucosa and mucosa or may be limited to the submucosa. In the latter instance, the zone of caseation progresses to involve the mucous membrane. Subsequently the area of caseation undergoes liquefaction (abscess) throug the action of proteolytic enzymes. The latter are liberated by the polymorphonuclear leukocytes which have migrated into the zone of caseation. We have never been impressed, as Renderath [16] has, that these abscesses are nonspecific in character and that they are sometimes surrounded by zones of nonspecific granulation tissue. Tuberculous granulation tissue always surrounded the liquefying zone in our cases.

After the liquefied caseous material has been evacuated, an ulcer is formed, which is lined by a zone of caseation. Beyond this is a zone of vascular granulation tissue which contains epithelioid and giant cells, sometimes arranged in tubercle formation. There may be an occasional oval or round epithelioid giant tubercle in the surrounding tissue, with and without a central zone of caseation.

The further course of the ulcer, similar in both modes of development, is that of either healing or progression.

Progression of the ulcer may occur from within or without. The tubercle bacilli passing over the ulcerated area from the lungs may result in progressive ulceration in the inner wall. Concomitant with this, the zone of granulation tissue becomes wider and the wall thicker. The mucous glands are replaced and separated by the granulation tissue. Atrophic as well as dilated glands are seen in these areas.

The ulcer may also enlarge through the rupture into the lumen of liquefied caseous foci present in the zone of granulation tissue and beyond it.

As the ulcer progresses, it may be lined by a zone of caseation in one region, by a pyogenic membrane in another and by vascular granulation tissue in still another area. These represent different stages in the development of the ulcer.

In deep-seated ulceration the cartilage is enveloped either by caseation or by granulation tissue. In some instances the cartilage is actually destroyed by caseation and granulation tissue. Caseation from the surrounding area extends to involve the neighboring cartilage, and this may subsequently undergo liquefaction. Granulation tissue first erodes the adjoining perichondrium and then the underlying cartilage. The diminishing cartilage has an irregular border and may be completely replaced by the granulation tissue. Partially destroyed cartilage may protrude into the lumen of the ulcer.

HEALING

Healing of a tuberculous ulcer may appear in any stage of anatomic development. While it is true that in most instances in which underlying chronic pulmonary tuberculosis undergoes anatomic healing the laryngeal ulcers also heal, there are cases in which laryngeal tuberculosis progresses after anatomic healing of chronic pulmonary tuberculosis. There were no such cases in this series. Thomson [5] stated that he has never seen laryngeal tuberculosis progress while the pulmonary disease underwent healing. Lukens [18] stated that one of the reasons why in some cases laryngeal tuberculosis progresses in spite of the fact that the pulmonary tuberculosis has been arrested is secondary infection by other organisms. Our own findings reveal that secondary infection of a tuberculous laryngeal ulcer is a rare occurrence. Although we have seen a few instances of secondary infection of tuberculous ulcers in the trachea and bronchi, we observed none in the larynx.

As the ulcer heals, the wall becomes smooth and granulation tissue fills in the lumen until the defect is obliterated. This is followed by a regenerated epithelium covering the surface. It is usually of a squamous type, even in the parts which were previously lined by a columnar type.

Occasionally, progression keeps pace with the healing process. These are the cases in which laryngeal tuberculosis continues after the underlying pulmonary tuberculosis has undergone anatomic healing. This is observed more frequently by laryngologists than by pathologists, because patients in these cases are amenable to treatment, with successful results in most instances.

The greater part of the larynx is affected by this process. The wall is thickened, and the lumen is greatly narrowed. The narrowing may be so great as to necessitate tracheotomy for relief and aid to its cure (Myerson [19]). The structure of the larynx is often greatly altered by irregular protrusions into the lumen. These elevations are red or brown and are smooth. Ulcers are observed in the intervening tissue.

Microscopically the picture is that of extensive tuberculosis occupying and altering almost the entire laryngeal wall. Wide zones of hyalinized connective tissue representing healed lesions are intermingled with tuberculous granulation tissue. Small and large, oval and round tuberculous foci, some with caseous centers and in all stages of anatomic development, are present throughout. The elevated areas are lined by hyperplastic squamous epithelium, beneath which is granulation tis-

18. Lukens, R. M.: The Larynx in the Tuberculous Patient, Arch. Otolaryng. **34**:110-116 (July) 1941.

19. Myerson, M. C.: Tuberculosis of the Larynx Requiring Tracheotomy, Arch. Otolaryng. **23**:1-17 (Jan.) 1936.

sue. The ulcers are lined by a pyogenic membrane with partial epithelization in some areas.

This stage of development has been variously designated by different authors as tuberculoma, pachydermia or granuloma.

CONCLUSIONS

Laryngeal tuberculosis was present in 304 (37.5 per cent) cases of tuberculosis which came to autopsy. In all but 2 instances it developed as a direct infection from positive sputum in chronic pulmonary tuberculosis. The age, sex and race distributions in this series parallel those in chronic pulmonary tuberculosis.

Tuberculous foci, with and without central zones of caseation, form in the walls of the larynxes as a result of tubercle bacilli which enter through the ducts of the mucous glands. Ulceration develops either through pressure atrophy of the mucous membrane by the tuberculous foci or by caseous necrosis of the overlying epithelium as the tuberculous areas enlarge. The further progression of the ulcerative process is similar to that in other parts of the body. Ulcers were found most frequently on the true vocal cords (47.1 per cent).

Healing may occur in any stage of anatomic development, usually in cases in which underlying chronic pulmonary tuberculosis undergoes anatomic healing. In some instances healing and progression keep pace in the same larynx, resulting in a pronounced thickening of the wall, nodular protrusions into the lumen and narrowing of the canal.

NASOPHARYNX IN AN EPIDEMIC OF STREPTOCOCCIC INFECTION

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THE RECENT epidemic of throat infection with group A, type 17, beta hemolytic streptococcus at Amarillo Army Air Field, Texas, presented interesting nasopharyngeal findings as seen with the nasopharyngoscope. A brief description of the ear, nose and throat complications that occurred in the epidemic is essential for evaluation of the nasopharyngeal study.

The offending organism was almost completely resistant to sulfonamide compounds but was sensitive to penicillin. The infections with the A 17 streptococcus flourished in spite of prophylactic treatment with sulfadiazine of all personnel on the field. Prior to and during the epidemic the sulfadiazine prophylaxis program reduced infections by other strains of streptococcus to near zero.

CLINICAL PICTURE

During the epidemic most of the patients with throat cultures positive for the A 17 streptococcus who were admitted to the hospital had severe respiratory infections or sore throats. Many of them had scarlet fever. The otitis media, the sinusitis and the infections of the throat were virulent and suggestive of scarlet fever, even when no rash was present. The infections of the lung were also virulent, with several cases of empyema. When open drainage was necessary the pleural pockets were found half filled with a thick exudate. Bizarre types of cervical phlegmon lateral to the thyroid cartilage and of collar type adenitis above the clavicle were frequent. Phlegmon of the lateral pharyngeal wall was commoner that the classic peritonsillar abscess. Two abscesses of the epiglottis and 2 cases of Ludwig's angina were among the complications seen.

In 70 per cent of the 47 cases of A 17 otitis media a myringotomy was required, in 20 per cent there was spontaneous rupture and in the remainder the infection subsided with thorough nasal shrinkage and large doses of penicillin intramuscularly. In 1 case mastoidectomy was required, but it would have been required in many cases except for penicillin. All the patients complained of tenderness of the mastoid process, and the pain continued for several days in spite of profuse seropurulent drainage. Roentgenograms of the mastoid process revealed

cloudiness and loss of cell wall detail. Edema of the posterior superior canal wall was common. In some cases there was so much swelling of the inner end of the canal that it was difficult to see the membrana tympani while doing a myringotomy. In a few cases there were blebs of the drum and inner canal wall.

In the case in which mastoidectomy was required the mastoid process was small and sclerotic, and the mastoiditis was complicated by a large tegment and zygomatic (extradural) abscess. This complication was definitely masked by penicillin and did not manifest itself until five days after therapy had been discontinued and eight days after the ear was dry. Hearing had not returned in the involved ear, and it was obvious that the infectious process in the middle ear had not completely resolved. The patient made an uneventful recovery after thorough surgical treatment of the mastoid process, and the hearing then returned to normal.

There was evidence that the organism became moderately resistant to penicillin. Early in the epidemic it was not unusual for a severe, virulent, suppurative otitis media to subside three days after myringotomy and adequate intramuscular injection of penicillin. Late in the epidemic, which lasted approximately two months, it was occasionally necessary to administer penicillin in amounts approaching 2,000,000 units to cure the infection of the middle ear and the mastoid process. In most cases hearing returned to near normal quickly after drainage had ceased.

Few of the pharyngeal phlegmons required incision and drainage, but they were often slow in subsiding. In 2 cases of early Ludwig's angina with throat cultures positive for A 17 streptococcus and with classic signs and symptoms of phlegmon of the floor of the mouth, there was complete recovery without incision. Penicillin produced such immediate improvement that delay of surgical treatment proved expedient.

Cases of extremely virulent sinusitis were the rule. The patients were very toxic with high temperatures, and they complained of severe pain. They had such pronounced nasal obstruction and excoriation of the nares and upper lip that local treatment was contraindicated. Usually their pain was gone after forty-eight hours of treatment with penicillin, but congestion and excessive discharge often persisted for ten days. Irrigation of the sinus was not necessary in most cases and, when done in the subacute stage, resulted in a rapid subsidence of symptoms. Penicillin was routinely instilled into the sinus after irrigation, with gratifying results.

THE NASOPHARYNX IN THE CARRIERS

During the epidemic those men on the field with throat cultures positive for A 17 streptococcus were placed in isolation barracks. Patients who were ready for discharge from the hospital, after recovery from A 17 streptococcus infections, were transferred to other isolation barracks if their throat cultures remained positive. Cultures of the nasopharynx and pharynx taken simultaneously in a test group revealed group A, type 17, beta hemolytic streptococcus in both areas.

Two hundred of these men with persistent, positive, throat cultures were carefully examined in the ear, nose and throat clinic. Table 1 gives a percentage listing of the results of these examinations. The nasopharynx was inspected by mirror and by nasopharyngoscope. The latter revealed considerable hypertrophy of the central adenoid mass in a large percentage of the cases. Inflammation and evidence of

TABLE 1.—*Results of Examination of Two Hundred Outpatients Whose Throat Cultures Were Positive for Type A 17 Streptococcus*

Tonsils present	79%
Sinusitis	30%
Adenoid tissue present	95%
Large central adenoid pad	78%
Adenoid mass so large that it obscured nasopharyngoscopic view of ostiums of eustachian tubes	57%
Adenoid tissue inflamed and swollen	79%

infection of the nasopharyngeal lymphoid tissue were the rule in these carriers, yet the faucial tonsils rarely showed any evidence of activity. Seventy-eight per cent of the carriers had large central adenoid pads and in 57 per cent the adenoid mass was so large that it obscured the ostiums of the eustachian tubes. Purulent discharge lying on the lymphoid mass was rarely seen except in patients who were ill. At the time of examination most of the carriers had had no symptoms, and only a few gave a history of mild sore throat, but many of them were later admitted to the hospital with active A 17 streptococcus infections.

CONTROLS

As a control series, 100 medical corpsmen were examined. These men had been constantly exposed to the cases of infection with A 17 streptococcus and yet had not been ill, and all had negative throat cultures. Table 2 is a tabulation of the results of examination of this control group. Although 44 per cent of this group had large adenoid pads, the nasopharyngeal lymphoid tissue was not inflamed and did not appear infected. Another control group of 96 men was examined

during a period when respiratory infections and infections of the throat with streptococcus were at a minimum. The results of this examination are given in table 3. Only 32 per cent of this group had a large, central, adenoid pad, and again the lymphoid tissue was not inflamed or swollen.

TREATMENT OF CARRIERS

Attempts were made to get 5 negative throat cultures before releasing men of the carrier group. Twenty of them were given penicillin displacement irrigations of the sinus on five successive days. Ten thousand units of penicillin in 20 cc. of isotonic solution of sodium chloride was used for each treatment. Cultures from 92 per cent of

TABLE 2.—*Results of Examination of One Hundred Medical Corpsmen with Negative Throat Cultures*

Tonsils present	59%
Sinusitis	12%
Adenoid tissue present	83%
Large central pad of adenoid tissue	44%
Adenoid tissue encroaching on ostiums of eustachian tubes	30%
Infected adenoid tissue	21%
No tonsils; large adenoid pad	17%

TABLE 3.—*Results of Examination of Ninety-Six Soldiers with Negative Throat Cultures*

Tonsils present	40%
Sinusitis	5%
Adenoid tissue present	68%
Large central adenoid pad	32%
Adenoid tissue crowding ostiums of eustachian tubes	22%

this group became negative immediately, but three days after treatment was discontinued cultures from half of them became positive again. Cultures from the other half remained negative, and the men were released from isolation. Penicillin throat and nasal sprays administered twice daily gave similar results.

Sulfadiazine administered by mouth, 6 Gm. daily for five days, resulted in no more negative throat cultures than were appearing in the control cases. Spraying the throat and painting the nasopharyngeal and pharyngeal lymphoid tissue with antiseptics gave disappointing results.

Penicillin given intramuscularly, 10,000 units every three hours for three days, resulted in 95 per cent negative cultures, and all remained negative.

Examinations of the nasopharynx of those members of the A 17 streptococcus carrier group whose cultures became permanently negative revealed an entirely different picture from that seen while they had positive cultures. The lymphoid tissue was still present and often hypertrophied, but evidence of inflammation and swelling had disappeared. In all cases the size of the adenoid mass had subsided by half, and the ostiums of the eustachian tubes were visible.

No tonsil or adenoid tissue was removed while throat cultures were positive because of a healthy respect for the virulence of the organism. Culturing the lymphoid tissue removed from patients whose cultures were formerly positive failed to reveal A 17 organisms.

The epidemic subsided as rapidly as it began and was brought under control by rigid isolation of patients with positive cultures and by well executed precautionary measures on the field. Occasional cases are still appearing but the infection is, for the most part, mild when compared to that encountered during the epidemic.

CONCLUSION

1. It seemed apparent that nasopharyngeal lymphoid tissue played a very important part as a reservoir of infection in this epidemic of infection with group A, type 17, beta hemolytic streptococcus.

2. Examination of the nasopharynx by mirror is inadequate when compared to inspection with the nasopharyngoscope for evaluating lymphoid hyperplasia and infection, but the magnification produced by the nasopharyngoscope must be kept in mind by the examiner.

3. Examination of the nasopharynx of a large number of young adults emphasizes the fact that in over half of them adenoid tissue had not become involuted. It also convinces one of the futility of attempted surgical removal of all hypertrophied nasopharyngeal lymphoid tissue. In 20 to 30 per cent of all the normal subjects examined lymphoid tissue was present in close proximity to the ostiums of the eustachian tubes. In this type of case a careful, thorough adenoidectomy followed by radium irradiation in the nasopharynx would seem to be the ideal method of treatment when removal of lymphoid tissue is indicated.

1908 Olds Tower, Lansing, Mich.

CARTILAGINOUS SEPTUM IN THE RECONSTRUCTION OF THE NOSE

A Modified Procedure

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AN INCREASING amount of attention has recently been given to the septal cartilage in the reconstruction of the nose.[1] The indications for this operation consist in correction of deviated noses and also relief of nasal obstruction in various degrees. In such cases the lower border of the cartilaginous septum is found to be protruding into one nostril, while the opposite nostril is distorted and the columella pulled toward the first side. Sometimes the columella is also retracted, especially when the deviation of the septum was originally caused by a fall on the tip of the nose. Also, the septal cartilage may be too short and the distance between the columella and the quadrangular cartilage too large, as a result of which the membranous septum is too long. There is often also a bulging of the upper lateral cartilage at the

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From the Department of Plastic Surgery, Downtown Hospital and Pan-American Clinic, Curt Engelmann, M.D., Attending.

1. (*a*) Cohen, S.: Lower Nasal Deflection, Arch. Otolaryng. **8**:399 (Oct.) 1928; (*b*) Role of the Septum in Surgery of the Nasal Contour, ibid. **30**:12 (July) 1939; (*c*) Plastic Surgery of the Nose, Laryngoscope **51**:363, 1941. (*d*) Cinelli, A. A.: High Cartilaginous Septal Trauma, Dis. Eye, Ear, Nose & Throat **2**:6, 1942. (*e*) Davis, W. B.: External Nasal Deformities and Methods Used in Their Repair, Arch. Otolaryng. **36**:619 (Nov.) 1942. (*f*) Ersner, M. S.: Reconstruction of the Deformed Nasal Septum, Arch. Otolaryng. **39**:476 (June) 1944. (*g*) Fomon, S.: Surgery of Injury and Plastic Repair, Baltimore, Williams & Wilkins Company, 1939. (*h*) McKenzie, W. R.: The Nasal Entrance, South. M. J. **35**:433, 1942. (*i*) Metzenbaum, M.: Replacement of the Lower End of the Dislocated Septal Cartilage Versus Submucous Resection of the Dislocated End of the Septal Cartilage, Arch. Otolaryng. **9**:282 (March) 1929; (*j*) Dislocation of the Lower End of the Nasal Septal Cartilage, ibid. **24**:78 (July) 1936. (*k*) O'Connor, G. B.: An Operation for the Correction of Atresia or Stenosis of the Anterior Nares, Arch. Otolaryng. **25**:208 (Feb.) 1937. (*l*) Peer, L. A.: An Operation to Repair Lateral Displacement of the Lower Border of the Septal Cartilage, Arch. Otolaryng. **25**:475 (April) 1937; (*m*) Cartilage Grafting, S. Clin. North America **24**:404, 1944. (*n*) Salinger, S.: Post-Traumatic Rhinoplasty: Secondary Correction of Septal Deviations and External Deformities of the Nose, Arch. Otolaryng. **37**:753 (May) 1943. (*o*) Seltzer, A. P.: The Nasal Septum: Plastic Repair of the Deviated Septum Associated with a Deflected Tip, Arch. Otolaryng. **40**:433 (Dec.) 1944. (*p*) Sheehan, J. E.: Plastic Surgery of the Nose, ed. 2, New York, Paul B. Hoeber, Inc., 1936.

side of the protrusion and/or a depression of or behind the tip because of lack of the proper support.

While the reconstruction of the external nose is accomplished according to more or less fixed principles, as originally described by Joseph,[2] the reconstruction of the septal cartilage requires ingenuity on the part of the surgeon and, as pointed out by Cohen [1b] and others, an individual technic in each case.

When the deviation of the quadrangular cartilage is only in or near its articulation with the perpendicular plate of the ethmoid, it is best handled by freeing the whole cartilage, separating the mucoperichondrium on one side only and removing a narrow strip of cartilage at the site of the deviation, thus eliminating the "spring."[11] This procedure enables one to swing the cartilage into its normal position as on a hinge.[11,o] At the same time, the lateral cartilages can be trimmed and corrections of the osseous vault may be accomplished if necessary.

But there are many cases in which the deviation and distortion is in the lower part of the septal cartilage, near the columella (subluxation of the septum), and in which Peer[11] stated that "the displaced lower border of septal cartilage is distorted and bound down by fibrous tissue" or in which the displaced lower border of septal cartilage consists of several pieces and layers due to trauma; occasionally each piece is observed to have a separate cover of perichondrium. Thus there is not an adequate support for the tip of the nose after removal of the distorted piece of cartilage. It is important not alone for cosmetic but much more for functional reasons that the nasal tip and the nares have the correct position; otherwise, aspiration of the alae and other disturbances of the function of the nose will result.

Before the surgical correction of such pathologic septal cartilage is undertaken, a thorough analysis of the case has to determine whether the quadrangular cartilage might be too long or too short or whether it has the correct length. In the cases in which it is too long by the distorted part, the procedure is simple: the septum is transfixed and this distorted part completely removed, the lateral cartilages trimmed and the operation completed. The removal of the distorted anterior border of the septal cartilage, however, is more difficult when the nose has the right size or especially when the septum is too short and/or the columella is retracted. In such cases my colleagues and I have been using an operative procedure in our department for many years with the best cosmetic and functional results, a description of which we have been unable to find in the literature at our disposal. We found descrip-

2. Joseph, J.: Nasenplastik und sonstige Gesichtsplastik, Leipzig, Curt Kabitzsch, 1928.

tions of operations only by Metzenbaum [10] and by Peer.[11] The latter one is similar to ours.

According to Peer,[11] "The anterior displaced segment of septal cartilage is completely removed, and the remainder of the septal cartilage is excised with the Ballenger swivel knife, care being taken to leave a beam of cartilage along the dorsum of the nose for support." After removal of obstructive bony elements of the septum, he implants a piece of the removed quadrangular cartilage, after trimming it to the right size, into a pocket in the columella.

We do not excise the entire quadrangular cartilage behind the removed displaced segment. We attach the greatest importance to leaving an untouched piece of cartilage as support immediately behind this segment. The outline of this support is, of course, shaped depending on the pathologic condition present. We proceed as in a submucous resection, taking care to leave a sufficient strip of cartilage along the entire dorsum of the nose. In Peer's operation the beam of cartilage along the dorsum of the nose and the implanted cartilage meet at an angle, the graft lying in front of the beam, which is left without any support. In our opinion there is the possibility that the dorsum of the nose might later sag, especially at the meeting angle, which is also the reason that such a support is left in the usual submucous resection. Our method precludes this risk of sagging. Corrections of the nasal bones if necessary may be done at the same time.

Our procedure is as follows:

After we have taken the history and photographs from different angles and made a general check-up and thorough study of the nasal deformity, the patient is prepared for the operation with 3 grains (0.19 Gm.) of sodium amytal by mouth two hours before and ¼ grain (0.015 Gm.) of morphine sulfate with 1/150 grain (0.0004 Gm.) of atropine sulfate subcutaneously one hour before the operation. After removal of the vibrissae, the insertion of cotton plugs (soaked in bichloride of mercury 1:1000) into the nostrils, the washing of the face and covering of it with sterile gauze, the patient is taken to the operating room. Here draping and local anesthesia with a 2 per cent solution of procaine hydrochloride with epinephrine are performed in the usual way. Then we make our standard incisions for submucous resection, which were taught by Engelmann for many years—an incision parallel to the dorsum of the nose on the convex side of the septum starting as high and as far backward as possible down to the anterior border of the quadrangular cartilage, the contour of which we follow downward to the nasal floor. (Should there be a big crest on or near the nasal floor, we make another horizontal incision on the floor of the nose to enable us to separate the mucoperichondrium beneath and on this crest from below upward.) We start the separation of the mucoperichondrium from the quadrangu-

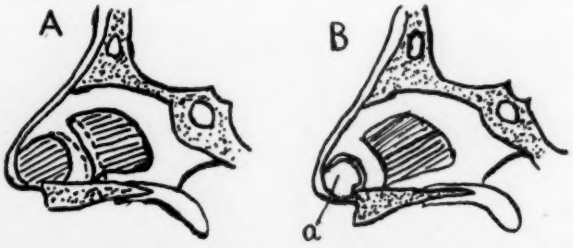
lar cartilage at the rear of the upper incision by moving the perichondrium elevator downward and forward. Thus it is easier to separate the fibrillae by which the mucoperichondrium is attached to the septum, and the danger of a perforation is considerably lessened. The separation is carried as far back over the perpendicular plate and the vomer as necessary. Then we make an incision through the cartilage as far backward as in each case advisable, in order to retain a wide support for the beam beneath the dorsum of the nose. Through this incision we elevate the mucoperichondrium on the concave side of the septum as far backward as required. The thus freed part of quadrangular cartilage is removed with the Ballenger swivel knife, a strip of cartilage being left along the nasal dorsum, and as much of the perpendicular plate and vomer is excised as necessary. Thereafter we make an incision behind and around the distorted segment through the cartilage far enough in front of the aforementioned incision to leave an untouched support, and we separate the mucoperichondrium on the concave side of the distorted segment from rearward except on its uppermost part—the extension of the beam along the dorsum. If it is difficult or impossible to separate this mucoperichondrium without the danger of causing a perforation, we do not hesitate to make a small incision on the bend of the deviation on the concave side of the septum. The anterior distorted segment of cartilage is removed except a small strip beneath the dorsum of the nose. Either this strip is shaved down to the right contour, or a narrow strip of cartilage is excised at the site of the deviation and the remaining cartilage swung back into the right position like on a hinge.

If any nasal plastic surgery has to be performed we begin the operative procedure with uncovering the nasal framework in the customary manner, by incisions sharp on the lower border of the upper lateral cartilages on both sides and by separation of the soft tissues and skin from the dorsum of the nose. The septum is then transfixed with button-end knife and scissors, and the upper lateral cartilages are severed from the septum and if necessary trimmed. Thereafter we make our upper horizontal incision for submucous resection, omitting the downward incision, instead of which we use the incision for transfixion of the septum.

Now a pocket is made into the columella from the tip down to the nasal spine. If desired, excessive tissue here may be removed. The small incision on the concave side of the septum, if previously made, is closed with dermal sutures no. 1, the Killian-Halle needle being used. If a transfixion of the septum was done, the incision on the concave side is sutured in the same manner. The removed quadrangular cartilage is precisely shaped so that it fits snugly into the pocket in the columella, i.e., between the nasal tip, the nasal spine and the carefully retained cartilage support for the nasal dorsum. If the septum was too short or

the columella retracted, this graft has to be wider and shaped so that it corrects the deformity. If necessary we attach this cartilage graft with one surgical gut mattress suture to the mucoperichondrium of the concave side. Then we close the vertical incision on the convex side in the same way the other one was closed. Occasionally it is advisable to implant a small piece of cartilage into the depression behind the tip on the dorsum of the nose, which is done through the incision along the upper lateral cartilage. Often the lower lateral cartilage of the nostril into which the septum was bulging has to be trimmed, and sometimes the same procedure has to be followed on the opposite side.

In certain cases in which we wish to avoid more trauma to the mucous membranes of the nose, we implant the cartilage into the columella between the two medial crura from beneath the upper lip in front of the anterior nasal spine, placing mattress sutures through the columella beneath the graft and closing the pocket with a few stitches.



1. Diagram of a cross section of the nose, showing the removed septal cartilage (shaded area) and some shapes (solid and dotted lines) of the support we leave. *B*, the same, showing the implant *a*.

Finally we place a dermal suture with a Hagedorn needle through the part of septal cartilage which we leave as support and the columella in the necessary level and tie it over small rolls of gauze to avoid stitch marks. If required we keep the columella narrow, with mattress sutures through its entire thickness, lead shots being used. Nasal packing remains in situ for about five days. To immobilize the nose and the tip, we place in some cases a stent mold [3] covered with lead over the adhesive strips, with which we support the newly shaped nose.

SUMMARY

The importance of the cartilaginous septum in the reconstruction of the nose, as well as the operative procedures for its correction, is discussed. A modified operation for removal of the anterior distorted part of the septal cartilage is reported.

114 East Fifty-Fourth Street.

3. Aufricht, G.: Dental Molding Compound Cast and Adhesive Strapping in Rhinoplastic Surgical Procedure, Arch. Otolaryng. **32**:333 (Aug.) 1940.

Case Reports

KELOID FORMATION IN BOTH EAR LOBES

D. F. WEAVER, M.D., DETROIT

THE TENDENCY of the skin of Negroes to form keloids following wounds is well known.

The following case is reported, first because it shows the formation of rather large recurring keloids following the simple procedure of piercing the ear lobes for the insertion of ear rings, and second because recurrence was apparently prevented by the use of roentgen rays.

REPORT OF A CASE

A Negro woman aged 33 presented herself at the outpatient department of the Henry Ford Hospital on Feb. 2, 1943. She stated that in 1933 her ear lobes had been pierced for the insertion of ear rings. A suture had been left in

A, patient with large keloids involving both ears. *B*, same patient thirty-two months after the excision of the keloids.

each wound. Four weeks after the operation the suture had been removed and ear rings inserted. Four weeks after insertion of the ear rings bilateral keloids began to form. In 1938 bilateral keloids as large as small black walnuts had been removed. Recurrence had been rather prompt, and a second removal had been carried out on the right side at a later date. No further treatment had been carried out.

On examination firm tumors were found involving both ear lobes. They appeared to be covered by squamous epithelium. The right measured 4 by 3 by 1.5 cm., and the left 3 by 2.5 by 2 cm. (*A* in figure).

No other significant physical abnormality was found.

On April 4, 1943, with anesthesia consisting of 1 per cent procaine hydrochloride infiltration, the tumors were completely excised, and the wounds were closed

with fine silk in such a way as to construct ear lobes which appeared as normal as possible.

A diagnosis of keloids was made on microscopic examination of the tumors.

The silk sutures were removed on the third postoperative day, at which time the patient was dismissed from the hospital.

On April 27, roentgen therapy was given over each field. The factors were: field size, 2 by 4 cm.; kilovolts, 150; filtration, 0.25 mm. copper and 1 mm. aluminum, and focal skin distance, 50 cm. The total dose was 195 r (measured in air).

On Dec. 15, 1945, thirty-two months after the excision of the keloids, the result appeared to be satisfactory (*B* in figure).

LEIOMYOMA OF THE LARYNX

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NEW YORK
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THE LEIOMYOMA, or smooth muscle tumor, has been described by all pathologists and is encountered frequently in the uterus, ovary, prostate, bladder, iris, alimentary tract, skin, etc., but in the available literature only 3 cases have been reported of leiomyoma in the larynx, 2 in the German literature and 1 by Jackson.

The first German case [1] was reported in 1912: A 10 year old boy was first seen seven months after the onset of a progressive hoarseness, which later i. e., two weeks prior to examination was complicated by difficulty in breathing. Inspection revealed a laryngeal tumor the size of a hazelnut filling the entire vestibule of the larynx, the color and surface of which were similar to those of the surrounding mucosa. Tracheotomy was done, and the removal of the tumor was accomplished by way of the endoscope. The vocal cords and the other portions of the larynx were found intact but there was a 5 mm. wound on the free edge of the left ventricular band close to the anterior commissure. This was apparently the site of origin of the tumor. Recovery was uneventful.

MICROSCOPIC EXAMINATION

The tumor was encapsulated by dense connective tissue which extended into the tumor itself without any defined boundaries. With Van Gieson's stain, the cells of the tumor were spindle shaped and contained a rodlike nucleus and more or less protoplasm. They stained yellow. They were grouped in both thin and wide fascicules which crossed one another in zigzag fashion. In cross section these cells showed either a round or a polygonal shape. The connective tissue of the tumor was scanty and poor in cells and stained intensive red. The yellow-stained fascicules of cells were edematous and showed occasional round cell infiltration on the periphery. The diagnosis was leiomyoma of the larynx.

A year later, M. Weil [2] reported the second case as follows: A tumor of the size of a bean, deep red, with a smooth surface and pedunculated, was found in the region of the posterior end of the left

1. Dongány, Z.: Leiomyoma Laryngis, Monatschr. f. Ohrenh. **46**:540, 1912.
2. Weil, M.: Leiomyoma Laryngis, Monatschr. f. Ohrenh. **47**:1040, 1913.

ventricle of a 67 year old man. The tumor was easily removed with a snare. A severe hemorrhage one hour in duration followed.

MICROSCOPIC EXAMINATION

A leiomyoma with fascicules of smooth muscle which crossed one another and stained yellow by the Van Gieson method was demonstrated. The author cited only 1 case as its precedent, the aforementioned case about which he made this comment: "In view of the great rarity of this kind of tumor, the question must be raised as to whether a great many cases have not been overlooked [i.e., of leiomyoma] since this diagnosis can be established only by Van Gieson stain."

Jackson [3] reported a case of a tumor having its origin in the esophageal wall, and he proceeded to point out an interesting fact, namely, that the growth extended up into the subglottic area, where it was visible by laryngeal mirror, pushing the cords apart. A specimen taken at that time showed an apparently benign tumor, but six months later, the tumor having increased in size, another specimen was taken which demonstrated sarcomatous changes. It is to be noted that this tumor was not a true tumor of the upper part of the larynx but originated in the esophagus.

REPORT OF A CASE

A 75 year old white man was first seen on April 4, 1945, by one of us (H. N.) and was admitted to Presbyterian Hospital on the same day complaining of difficulty in speaking and breathing for sixteen years, both symptoms having become progressively more pronounced during the past few months. Difficulty in swallowing developed shortly prior to his admission. The patient had been resistant to operation for fear that he would be obliged to depend on a tracheotomy tube for the duration of his life. He was elderly, emaciated and anemic, and his speech was hardly intelligible. Examination of the ear, nose and throat gave negative results except for the larynx. Under indirect laryngoscopy, a large round smooth mass, completely filling the vestibule, could be seen. Large blood vessels could be visualized on the surface, and the mass appeared to originate in the right aryepiglottic fold. The underlying structures of the larynx could not be seen because of tumor obstruction. Laminagrams of the larynx taken at 15, 14 and 13.5 cm., together with a left lateral view of the neck, showed evidence of a rounded soft mass of tissue occupying the vestibule of the larynx. It appeared to arise on the right side in the region of the aryepiglottic folds. It did not appear to involve the vocal cords. On the same day, direct laryngoscopy was done, and observations coincided with the picture which has been given. Because of fear of angioma, a specimen for biopsy was not taken. On April 6 a tracheotomy was done to relieve dyspnea and in anticipation of further surgical treatment. On April 18 the patient was taken to the operating room for removal of the tumor.

Operative Procedure.—With the patient under intravenous pentothal sodium anesthesia, a horizontal incision was made on the right side of the neck just below the hyoid bone. The deep cervical fascia was opened. Bleeding from

3. Jackson, C., and Jackson, C. L.: Leiomyoma of Larynx, in Diseases and Injuries of the Larynx, ed. 2, New York, The Macmillan Company, 1942, p. 396.

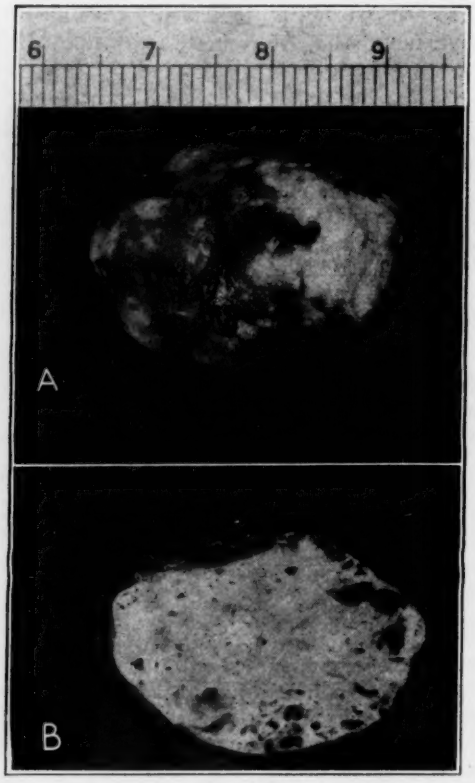

Fig. 1.—Gross specimen of leiomyoma of the larynx: *A*, external view; *B*, cut surface.

Fig. 2.—Photomicrograph, low power.

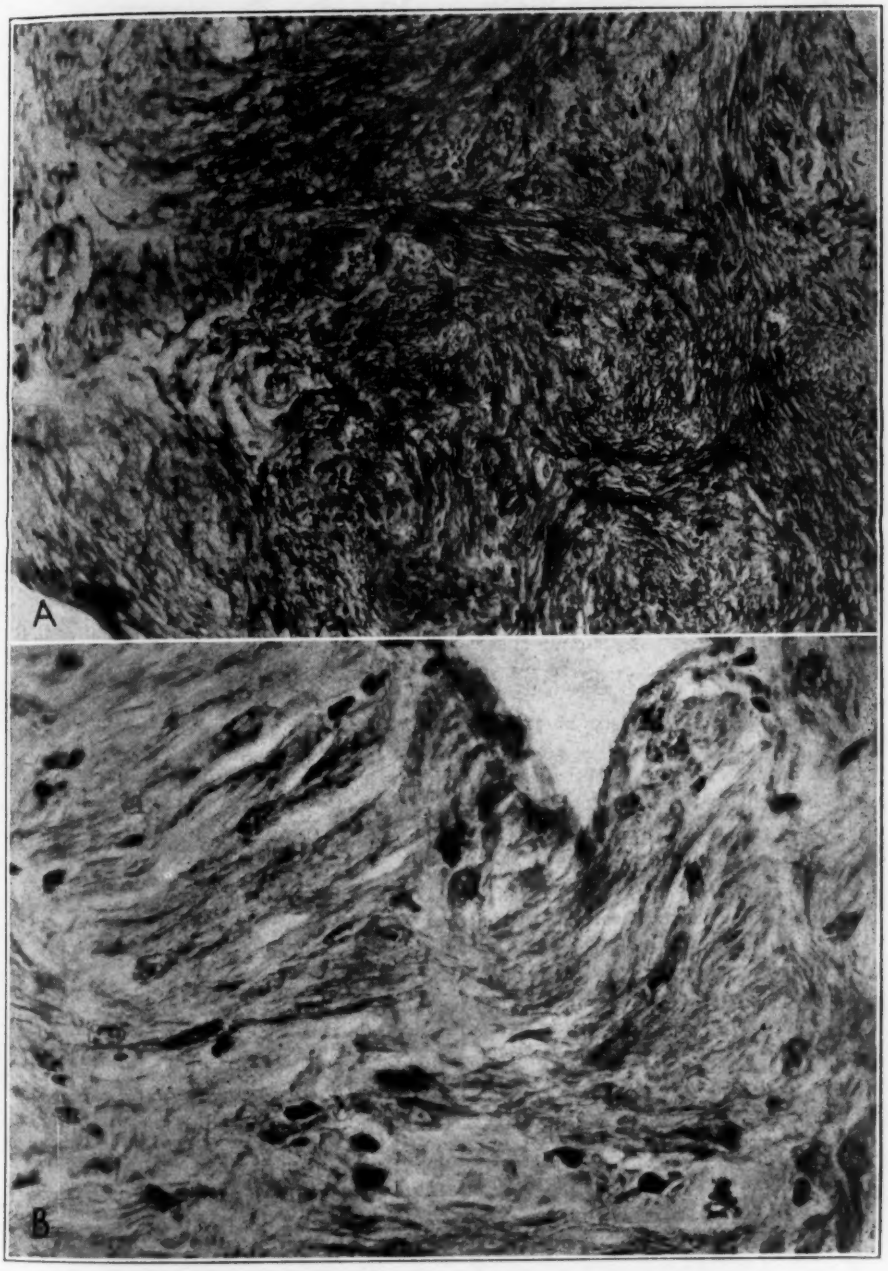

Fig. 3.—Photomicrographs: *A*, medium power; *B*, high power.

superficial vessels was controlled by clamping and electrocoagulation. The thyrohyoid muscles were cut so as to obtain a better view. The right submaxillary gland was liberated and retracted upward. After the thyrohyoid membrane had been incised, the tumor mass, which was the size of a walnut, could be seen. The membranous envelope of the cystic mass was then incised, and the tumor itself was removed by blunt dissection. The mass was oval in shape and firm and had a smooth surface. Alongside of the right edge of the tumor mass, the hypopharyngeal space was exposed. This exposure was then closed with chromic catgut sutures. A rubber drain was left in the cavity created by removal of the tumor mass. The thyrohyoid muscles were sutured. The fascia was also sutured with catgut. The right superior laryngeal artery was tied, and the skin was then closed with silk sutures. A feeding tube was inserted in the esophagus.

Pathologic Report on the Tumor.—Gross Observations: The specimen, said to come from the larynx, came in Bouin's solution and consisted of an ovoid mass measuring 3.2 by 2.5 by 2 cm. It was soft, and on sectioning it showed a cortical zone which had a spongeous appearance and contained a great number of small spaces filled with blood. The more central portion was pale gray and translucent. It contained spaces similar to those of the peripheral zone but much smaller.

Microscopic Observations: Sections showed that the tumor was well encapsulated. It was made up of a great number of interlacing bundles of smooth muscle, some of which surrounded the numerous vascular spaces present in the tissue. These smooth muscle cells were associated with a considerable amount of connective tissue stroma. The already mentioned vascular spaces were unusually large and tortuous and lined with flattened endothelial cells. As already stated, many of them were surrounded by bundles of smooth muscle which, however, seldom formed regular muscular walls. The stroma showed numerous areas of considerable edema. There was minimal inflammation. The tumor was certainly benign.

This was a leiomyoma of the vascular type. They are usually believed to take their origin from the smooth muscle of the blood vessels. These tumors must be rare in the larynx. In fact, this was the first leiomyoma of the larynx recorded in this laboratory (Presbyterian Hospital).

Diagnosis.—Leiomyoma (vascular type) of the larynx (aryepiglottic region) was diagnosed.

Convalescence was complicated by cardiac decompensation and prostatic obstruction. The tracheal tube was left in situ for two months because the sac from which the mass had been dissected had apparently filled with blood clots which were not completely absorbed. At present, four months after the operation, the tracheotomy wound is completely healed, the patient's speech is almost perfect, and there is only a slight thickening at the site from which the tumor was removed.

COMMENT

The significance of this first true leiomyoma of the upper part of the larynx reported in American literature is scientific rather than clinical.

LARYNGOCELE

MAJOR MAC. D. CAMPBELL
MEDICAL CORPS, ARMY OF THE UNITED STATES

A REVIEW of the literature on this subject, furnished by the package-lending library of the American Medical Association, leaves one with a confused idea of the actual status of true laryngocele and of the number of cases that have been observed and reported. Two cases of laryngocele have been seen by one laryngoscopist, who has had a great many years of experience.[1] Another specialist reported 85.[2]

REPORT OF A CASE

History.—A single man aged 38 was admitted to the Regional Station Hospital, Orlando Army Air Base, Orlando, Fla. He complained of having had sore throat, off and on, for many years. Three months ago a small swelling in the left side of the neck had been noticed that was not related to eating or drinking, but usually became enlarged after a bout of coughing. At the time of the patient's admission it had reached the size of a hen's egg. Pressure on the soft swelling gave the patient the sensation of air escaping in the throat, associated with a squealing noise.

Physical Examination.—The physical examination revealed no abnormalities with the following exceptions:

1. A visible tumor that rose with swallowing was located in the anterior superior triangle of the left cervical region. The size varied from that of a tangerine to that of a hen's egg. It was soft and compressible and could be collapsed with a squealing sound when the patient's mouth was open.

2. A deliberate effort to inflate the laryngocele by closing the mouth and nose was not successful, but inflation required a series of swallowings. During these thyroid excursions, the tumor was observed to inflate.

3. Indirect and direct laryngoscopy revealed nothing abnormal. An unsuccessful effort was made, during compression, to find the hole that allowed the escape of air and the squeal.

4. The roentgenologic report of Captain R. L. Stephens included an anteroposterior and a lateral view of the cervical part of the spine, showing a cystlike tumor approximately 6 by 4 by 4 cm., located on the left side of the neck at the level of the hyoid bone. The lesion was filled with air and displaced the larynx to the right. Fluoroscopy of the upper part of the esophagus with barium administered by mouth failed to reveal any communication between that part of the esophagus and the lesion.

From the Army Air Forces Regional Station Hospital, Orlando Army Air Base, Orlando, Fla.

1. Jackson, C., and Jackson, C. L.: Diseases and Injuries of the Larynx, New York, The Macmillan Company, 1942, p. 358.

2. Moore, I.: The So-Called Prolapse of the Laryngeal Ventricle and Eversion of the Sacculus, J. Laryng. & Otol. **37**:265, 333 antl 381, 1922.

The patient was transferred to the care of the Chief of Surgical Service, Colonel H. P. Zeigler and operated on by him. With the patient under gas and ether anesthesia given intratracheally, an incision was made parallel to and 1 inch (2.54 cm.) below the angle of the jaw on the left side, extending from just behind the angle to the midline. The platysma muscle and the deep fascia were incised, and a plum-sized tumor was isolated by sharp dissection. It was pear shaped, base down, and was traced to its origin through a small pedicle into the larynx in the midline just above the top of the thyroid cartilage. The stalk was excised, and the stump was closed by a transfixation suture and a plain ligature of cotton. The sac seemed to consist of little more than a mucous membrane. Attempt was made to close the defect between the greater horn of the hyoid and the upper border of the thyroid cartilage by suturing the omohyoid muscle over it. The deep fascia and the platysma muscle and the skin were closed separately with interrupted sutures.

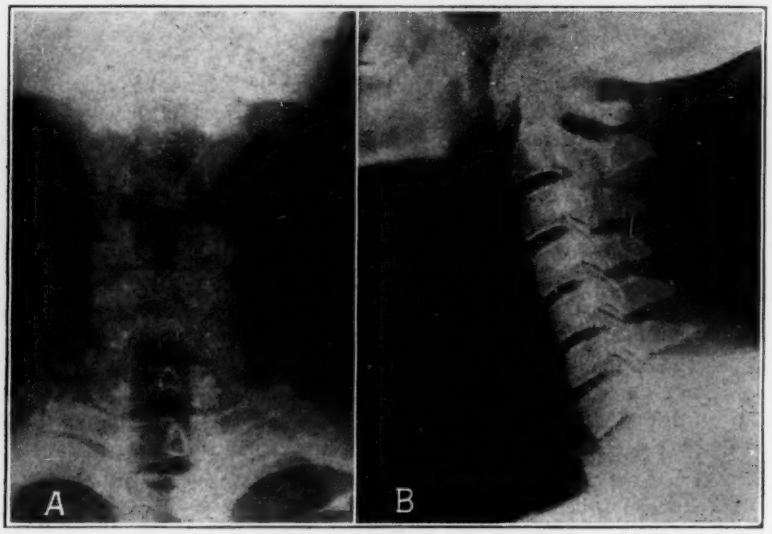

Fig. 1.—Roentgenograms of the cervical part of the spine, showing a cystlike tumor. *A*, anteroposterior view. *B*, lateral view.

The postoperative course was uneventful, and the patient was discharged on the fourteenth day.

The pathologic report of Lieutenant Colonel J. N. Patterson revealed the following:

Gross Description.—The specimen consisted of a fluctuant mass of tissue measuring 4 by 3 by 1.5 cm. Its base broadened out when it was laid on a flat surface. A small opening was noted in one end of the mass. A small pointed pair of scissors was used to open this tract, which extended into a large thin-walled cavity containing a yellow-gray turbid fluid. The cavity was lined with a smooth moderately injected membrane.

Microscopic Description.—The sections presented an epithelium-lined tract with its connective tissue wall. In one section the wall was thick, showing considerable congestion of the vessels with diffuse and focal areas of lymphocytic infiltration. An occasional polymorphonuclear neutrophilic leukocyte was seen. In the other section the wall was rather thin and contained mixed glands in its

submucosa. The epithelium throughout was of a stratified ciliated columnar type, although in many portions only the basal layer of cells was seen. Many goblet cells were scattered throughout the epithelium. A small ulcerated area was noted in this section in which there was a heavy infiltration of lymphocytes and plasma cells and in which to a lesser degree there were polyps.

Diagnosis.—The diagnosis was diverticulum of the larynx with active chronic mural inflammation.

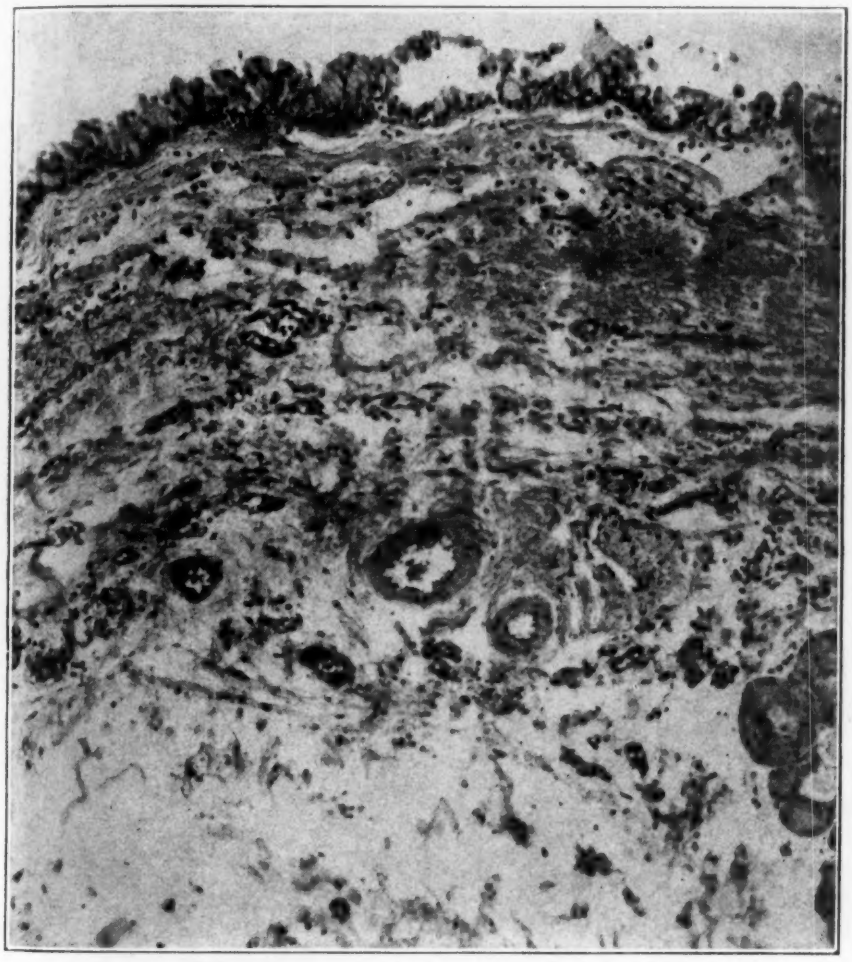

Fig. 2.—Photomicrograph of cut surface of laryngocele.

COMMENT

Dr. Charles H. Allman and Dr. David P. Cordray[3] of Boston divide laryngoceles into three classes: (1) internal, a cystic dilatation within the larynx;

3. Allman, C. H., and Cordray, D. P.: Laryngocele, Ann. Otol., Rhin. & Laryng. **49**:661, 1940.

(2) superior external, a cystic dilatation of the sacculus of the ventricle of Morgagni that penetrates the thyrohyoid membrane just above the upper rim of the thyroid cartilage and anterior to the superior cornu or just lateral to the thyroid notch, and (3) a combination of (1) and (2).

The foregoing report of laryngocele conforms to class 2, and the condition may be described as a superior external laryngocele.

Progress in Otolaryngology

Summaries of the Bibliographic Material Available in the Field of Otolaryngology

OTITIS MEDIA AND COMPLICATIONS

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PASADENA, CALIF.

NUMEROUS articles in 1944 appeared concerning the use of the sulfonamide drugs, and a few reports were made on the use of penicillin. Foreign publications are still hard to obtain. Some articles are quoted and commented on under several headings. Editorial comments appear in brackets.

DIAGNOSIS

Danelius[1] advises the technic of Mayer to show the mastoid antrum, attic and tympanic cavity. This view is valuable in suspected attic cholesteatoma and chronic otitis media. [He has offered the best description I have seen of this technically difficult Mayer position.]

Lindsay[2] uses the Stenver position to visualize the posterior group of cells in the petrous pyramid except for the small group of cases in which a group of cells lies between the aquaeductus endolymphaticus and the posterior cranial fossa. This group, 5 to 10 per cent of the cases of petrositis, requires an occipital projection. The anterior group of cells, extending from the hypotympanum or the tubal orifice, is best shown by a mentovertical view.

Tamari[3] advises diagnostic puncture and aspiration of the mastoid in cases in which the diagnosis of acute mastoiditis is uncertain. He uses a sternal puncture needle which has a stylet and a depth guard. He uses this procedure only in cases in which roentgenologic examination has shown the mastoid to be pneumatic and the position of the lateral sinus to be normal. [It seems to me that an exploration of the mastoid by the usual simple mastoidectomy would be a safer and much more reliable procedure.]

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1. Danelius, G.: The Value of the Axial Projection of the Petrous Bone in the Diagnosis of Chronic Mastoiditis and Cholesteatoma, Radiology **43**:492-498 (Nov.) 1944.

2. Lindsay, J. R.: Recent Progress in Management of Acute Suppuration of the Middle Ear, Arch. Otolaryng. **39**:492-497 (June) 1944.

3. Tamari, M.: Mastoid Puncture, Eye, Ear, Nose & Throat Monthly **23**: 270 (July) 1944.

Von Leden and Williams [4] report a case of chronic mastoiditis in which there was an erosion of the horizontal semicircular canal, producing labyrinthitis. The roentgenograms showed little evidence of infection on the diseased side and an apparent cholesteatoma on the normal side. "This case illustrates that a laboratory test, such as a roentgenographic examination, may be misleading, and that when laboratory findings conflict with clinical findings the greater weight should be given to the latter."

BACTERIOLOGY

Lothrop [5] reports a case of lateral sinus thrombosis in a man of 25 who had had a discharging ear most of his life. Three cultures of the blood which were positive for Bacillus proteus were obtained after mastoidectomy and ligation of the jugular vein, so the lateral sinus was uncovered and found to be thrombosed to the torcular Herophili. Recovery followed. Large doses of sulfapyradine were used. He had found only 9 cases reported since 1912, all fatal except 1.

McKee [6] reports a case of lateral sinus thrombosis and septicemia due to B. proteus in which the patient was cured by sulfapyridine. In his review of the literature he found that B. proteus could cause virulent otitis media, with necrosis to the dura and lateral sinus in a few days. He observed 21 patients with otitis media, 7 of whom survived. Meningitis and brain abscess were fairly common, and they were usually fatal in a few days.

Sugar [7] reports another case of infection with B. proteus, in a boy of 11. The patient had had a draining ear for a long time. Dizziness began three weeks before operation. A polyp was removed. Results of a fistula test were normal. In thirty-six hours, the meatus was again filled with granulations, and a radical operation was done. Symptoms of meningitis developed rapidly, and death occurred two days later.

B. proteus is a member of the colon group and is found most commonly in urinary infections, usually those of a mild form. It is a secondary invader in chronic otitis media and may become pathogenic.

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4. Von Leden, H., and Williams, H. L.: Cholesteatoma with Fistula into the Labyrinth, Arch. Otolaryng. **39**:432-433 (May) 1944.

5. Lothrop, O. A.: Otogenous Infection Due to the Proteus Bacillus, New England J. Med. **229**:867-868 (Dec. 2) 1943.

6. McKee, T. L.: Bacillus Proteus Infections: Review of Literature and Report of a Case of Septicemia of Otitic Origin Treated with Sulfapyridine with Recovery, Arch. Otolaryng. **39**:398-402 (May) 1944.

7. Sugar, M.: Meningitis Following Mastoid Infection by Bacillus Proteus, J. Laryng. & Otol. **59**:146-150 (April) 1944.

Collins and Hughes [8] found this organism in thirteen of twenty-six chronically discharging ears.

Odom, Rodenburg and Schain [9] report a case of a man of 38 who received a traumatic perforation by a twig while rabbit hunting. When he was seen eleven years later, there was a large perforation of the drum with a slight purulent discharge, in which there were small whitish nodules resembling small, half mothballs, about 1 mm. in diameter. Ten per cent thymol in oil apparently cleared up the infection, but it recurred three weeks later. A roentgenogram of the ear showed partial sclerosis. The chest was normal. Culture showed Streptomyces albus (actinomycosis). In a search of the literature they found only a few cases of the infection involving the ear and none in which the infection had definitely started in the ear. [A few years ago 2 patients with actinomycosis with multiple draining sinuses in the head and neck were treated at the Los Angeles County Hospital with large doses of sulfonamide drugs and were apparently cured. The opinion of our research bacteriologists is that the effect of the sulfonamide compounds may have been on the secondary infections and that any beneficial effect on actinomycosis by the sulfonamide drugs (or penicillin) has not yet been proved.]

CHEMOTHERAPY AND BIOTHERAPY

In a symposium on chemotherapy by the Royal Society of Medicine [10] the fifteen speakers all emphasized the early administration of the sulfonamide compounds (sulfonamides in England). Its misuse was said to be chiefly inadequate dosage and, in otitis media, failure to incise the drum and reliance on the "sulphonamides to produce results under unfavorable local or general conditions. *Local:* Infection with fluid under tension; *General:* Ambulatory treatment; and where frequent recurrences of infection have occurred in the same mastoid."

The first speaker, Mr. W. Stirk Adams,[10] states that while in 1935, the last year before the use of sulfonamide drugs, 63 per cent of 250 patients admitted to the Children's Hospital, Birmingham, England, for acute otitis media required mastoidectomy in 1942 only 32 per cent of 350 patients admitted required operation.

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8. Collins, E. G., and Hughes, K. E. A.: The Treatment of Chronic Suppurative Otitis Media by Local Application of Penicillin and Other Drugs, J. Laryng. & Otol. **59**:81-85 (March) 1944.

9. Odom, S. G.; Rodenburg, E. J., and Schain, P.: Streptomyces Albus in Ear, Arch. Otolaryng. **39**:137-143 (Feb.) 1944.

10. Adams, W. S., and others: Discussion on the Use and Misuse of Sulphonamides in Otitis Media, Proc. Roy. Soc. Med. **37**:743-750 (Oct.) 1944.

In another symposium Cunning [11] states:

Penicillin is far superior to any of the sulfonamide compounds in the treatment of Staphylococcus aureus infections with or without bacteremia. . . . It is also extremely effective in the treatment of infections with hemolytic streptococci, pneumococci and gonococci, which are resistant to the sulfonamide compounds. . . .

Penicillin does not enter the meningeal spaces or the spinal fluid after intravenous or intramuscular injections. Therefore, in addition to being injected intramuscularly or intravenously, it must be given directly into the spinal fluid in the treatment of meningitis. . . .

The adequate or the optimum dosage has not been clearly defined to date. . . .

For serious infections due to the hemolytic streptococci . . . with or without bacteremia an initial dose of 15,000 to 20,000 Oxford units should be given, with continuing dosage as follows: 5,000 units every hour injected into the tubing of an inlying intravenous set. There should be constant intravenous injection of a solution at a rate designed to deliver 5,000 to 10,000 units per hour. . . . After the temperature has returned to normal, the total dose in the twenty-four hour period may be reduced one half, but it should be administered for at least seven days after the temperature is normal. . . .

For meningitis 10,000 units of penicillin in isotonic solution of sodium chloride is injected into the subarachnoid space or intracisternally once or twice daily; the solution is also given intravenously or intramuscularly at the same time.

White [11] says that he has seen acute otitis media develop in patients at the time they were being treated with penicillin. "The statement made by Dr. Cunning that he felt that in the future penicillin might take the place of sulfonamide compounds I take exception to. . . . The use of penicillin against pneumococcic meningitis has proved to be of limited value . . . it remains to be determined, also, how it should be used in conjunction with the sulfonamide compounds." [The latest opinion is that both the sulfonamide drugs and penicillin should be given in full doses in meningitis, septicemia and other serious infections.]

Kolmer [12] advised the use of immune serums in addition to the sulfonamide drugs and penicillin in septicemia and acute suppurative meningitis.

Lindsay [2] states that the most effective time for administration of the sulfonamide compounds in acute otitis media is in the invasive or the preinvasive stage. "In the presence of a severe infection of the

11. Cunning, D. S.; Kolmer, J. L., and White, W. L.: Symposium on Chemotherapy and Biotherapy in Otolaryngology, Arch. Otolaryng. **40**:229-231 (Sept.) 1944.

12. Kolmer, J. L.: Chemotherapy and Biotherapy, Arch. Otolaryng. **40**:17-29 (July) 1945.

upper respiratory tract the first signs of invasion of the middle ear should be the indication for considering such therapy."

Several articles about the local treatment of chronic suppurative otitis media appeared, one dealing with the use of penicillin locally.

Collins and Hughes [8] treated twenty-six ears (23 patients, 3 with bilateral involvement) with penicillin and other drugs and controlled the series with careful bacteriologic study; five hundred and forty cultures and three hundred smears were made. Many organisms, including some of the staphylococci and streptococci, were not sensitive to penicillin. The penicillin was used in a concentration of 800 to 1,000 units per cubic centimeter and was forced through the perforations with a Politzer bag. A wick was then placed in the ear and kept moist by the application of more solution every eight hours. "Our conclusion with regard to the local application of penicillin is that the results are definitely disappointing." In 4 of the 9 patients treated with penicillin a dry ear was obtained. In 12 of the remaining 14 patients a dry ear was achieved by other treatment. A saturated solution of boric acid in 75 per cent alcohol was used in 16 patients and was effective in about half of the patients having diphtheroid or coliform bacilli. Boric acid powder, used in 9 patients, was a little more effective than the boric acid and alcohol drops. Sulfonamide powders were tried, and best results were obtained with a mixture of sulfanilamide powder and 15 per cent Mikraform sulfathiazole. Sulfathiazole administered perorally was given in 10 patients, 39 Gm. over seven days, and apparently helped in 5 patients. Illustrations of the perforations and tables of results are given.

Banham [13] treated 200 patients with chronic suppurative otitis media at one Royal Air Force center. The cases are described in detail, with special reference to the otoscopic appearance. The essentials of the treatment are thorough frequent cleansing and insufflation of powder such as boric acid and sulfathiazole. One hundred per cent of the patients with central perforations were cured. Many ears with granulations cleared up and became dry. Eighty per cent of the 200 patients "responded satisfactorily" to local treatment.

Miller [14] reports that 84 patients with acute otitis media were treated by insufflation of sodium sulfathiazole. The average ear was well in six days, and none drained longer than eighteen days. [It is difficult to believe that a sulfonamide powder would get through the usual small

13. Banham, T. M.: The Conservative Treatment of Chronic Suppurative Otitis Media in Adults, J. Laryng. & Otol. **59**:117-135 (April) 1944.

14. Miller, M. E.: Treatment of Acute Suppurative Otitis Media by Local Sulfonamide Therapy, J. Indiana M. A. **37**:11-12 (Jan.) 1944.

perforation through which pus was draining continuously in acute otitis media. It is easier to believe that there may have been a mild epidemic in which 84 patients with otitis media might recover spontaneously in an average of six days.]

Boies [15] found the use of iodine powders and boric acid as effective as sulfonamide powder. In treatment of chronic otitis media without complications he relies on the local use of powder and the removal of infections and obstructions in the upper respiratory tract.

Two authors report on the use of sulfonamide drugs packed in mastoid wounds.

McDougall [16] abstracts 15 cases in which radical mastoidectomies were done, a postaural incision being used. The cavities were then packed firmly with sulfathiazole crystals. Only 1 patient had a mild rash for two days. "It is very important to keep the cavity firmly packed for at least two weeks." He states that the postoperative period of treatment is greatly shortened and the usual painful removal of packing is eliminated. He packs his simple mastoidectomy cases in the same way and considers the results "phenomenal."

Herzig [17] has used complete closure in his simple mastoidectomy wounds for many years. He reports 7 cases in which he used equal parts of sulfanilamide and sulfathiazole powder packed into the mastoid cavity. He reports earlier healing than usual and no reactions. [Large amounts of powder may possibly cause irritative reaction in the middle ear, with possible later impairment of hearing.]

Voorhees,[18] in describing the technic used during his residency at the New York Eye and Ear Infirmary, said that sulfonamide powders were not used in the wound postoperatively. He had seen such a case in which the wound broke down and required a plastic closure. [The majority of operators dust a small amount of one of the powders into postoperative wounds and use a small rubber drain at the lower edge of the wound.]

In treatment with penicillin or sulfonamide compounds, it must be stressed that when there is a condition existing requiring surgical treatment, operation must be done. When a patient has a bulging

15. Boies, L. R.: Middle Ear Disease in Children, Journal-Lancet **64**:361-365 (Nov.) 1944.

16. McDougall, C.: The Use of Sulfathiazole Powder in Radical Mastoidectomies, Tr. Am. Laryng., Rhin. & Otol. Soc. **49**:157-164, 1944.

17. Herzig, A. J.: The Use of Sulfonamide Drugs in the Mastoidectomy Wound Where Complete Closure Is Employed, Laryngoscope **54**:199-208 (May) 1944.

18. Voorhees, D. G.: Indications, Procedures and Results in the Surgical Management of Mastoiditis, Arch. Otolaryng. **40**:249-260 (Oct.) 1944.

drum, it should be opened and administration of sulfonamide or penicillin drugs continued. In mastoiditis, if there are indications, one should operate and then continue the administration of sulfonamide drugs or penicillin. If chemotherapy is given early, it may prevent surgical lesions. The indications for operative intervention exist today as before the days of chemotherapy and must be acted on accordingly. Serious intracranial complications may develop in spite of sulfonamide or penicillin therapy or may be present when the therapy is started and kept quiescent for a time by the treatment.

MASKING

Lindsay,[2] in commenting on so-called masking, says: "This masking effect is, however, merely an indication of the efficacy of the therapy in inhibiting the extensions of the infection. The patient should not be denied this protection."

Sellers [19] expressed the opinion that serious masking may occur if sulfonamide compounds are given after suppuration is present.

AERO-OTITIS AND PURULENT OTITIS MEDIA

Major Wright [20] reports that in 6 per cent of 100,000 men who made "routine flights" in the low pressure chamber at Santa Ana Army Air Base aero-otitis developed. Of these 6,000, in 30, or 5 per cent, purulent otitis media developed. One mastoidectomy was done. This is the first report of suppurative otitis media after flight. [Why so little acute suppurative otitis media has developed after aero-otitis has been an unsolved problem.]

ACUTE OTITIS MEDIA AND MASTOIDITIS

Sellers [19] concludes that sulfonamide compounds reduce the incidence of otitis media in acute infection of the upper respiratory tract but "do not lower the incidence of mastoiditis in acute suppurative otitis media if the cases are otherwise properly handled." [Most observers report about a 50 per cent lowering of incidence of mastoiditis in otitis media if the sulfonamide drugs are given in proper dosages.]

Voorhees [18] found that in deciding for or against operation in acute mastoiditis there were numerous important considerations. Profound loss of hearing indicated mastoid involvement. In his opinion, "surgical intervention in mastoiditis following acute purulent otitis media need

19. Sellers, L. M.: Acute Mastoiditis Following Sulfonamide Therapy, Texas State J. Med. **40**:297-303 (Sept.) 1944.

20. Wright, R. W.: Aero-Otitis Complicated by Purulent Otitis Media, Air Surgeons Bull. (no. 6) **1**:8-9 (June) 1944.

not be considered until three weeks after the initial onset of symptoms, which are fulness, pain, loss of hearing, headache, possibly discharge and tinnitus; any mastoidal pain or tenderness observed prior to that time is, I believe, due to edema in the cells of the mastoid process." Pneumococcus type III is an exception to this rule. [This is a readable article and shows much thought and observation. However, it is unsafe to set an arbitrary limit of three weeks during which a mastoidectomy need not be considered necessary.]

Dean [21] investigated death rates reported from otitis media and comments on their inaccuracy. He urges more care of otitis media in childhood and, while giving chemotherapy credit for its great value, warns against overconfidence in its use. His reports of 2 cases will be commented on later, under their proper headings.

Commander Koebbe and Lieutenant Commander Potter [22] report an unusually high incidence of complications of acute otitis media during a period of six and one-half months at a receiving hospital for a naval district. There was an average daily census of 380. More than one half of these patients had acute aural infections. The total number of cases of otitis media is not given, but one hundred and seventy mastoidectomies were performed. There were sixty-four complications:

	Cases	Percentage with Recovery
Meningitis	20	100
Thrombosis of a lateral sinus	14	100
Subperiosteal abscess and Bezold's abscess	10	100
Encephalitis	6	100
Abscess of the brain	3	33.3*
Paresis of the seventh nerve	6	100
Paresis of the sixth nerve	3	100
Suppurative labyrinthitis	1	100
Petrositis	1	0*

* One patient who died had a cerebellar abscess and petrositis.

A complete chart is given of the symptoms and treatment of 1 patient with meningitis.

The excellent results obtained are credited largely to penicillin. [Excellent management must have been present also.] No unfavorable reactions to penicillin were seen. Further comment will be made under later headings.

Hallberg and Thornell [23] report a case of a girl of 4½ years who had a cold and transient pain in the ear two weeks before admission. On examination the drum was found to be absolutely normal, and the

21. Dean, W.: Otitis Media Still Takes Its Toll, South. M. J. **37**:17-20 (Jan.) 1944.

22. Koebbe, E. E., and Potter, J. J.: Complications of Otitis Media and Their Treatment, Arch. Otolaryng. **40**:382-384 (Nov.) 1944.

23. Hallberg, O. E., and Thornell, W. C.: Masked Mastoiditis, Minnesota Med. **27**:284-309 (April) 1944.

mastoid was tender and edematous. Mastoidectomy revealed pus and necrosis. The usual explanation of this phenomenon is that the infection passed through the middle ear to the mastoid followed by a sealing off of the aditus ad antrum, allowing the middle ear to recover while the infection proceeded in the mastoid.

CHRONIC OTITIS MEDIA AND MASTOIDITIS

Boies [15] divides chronic otitis media into four types: Cases of type I have odorless discharge with a central perforation. Cases of type II have a central perforation, mucopurulent secretion and granulations or polypi. In cases of type III there is disease in the attic, the perforation is in Shrapnel's membrane or along the posterior margin and necrotic changes in the bone may be present adjacent to the perforation. The discharge is foul; cholesteatoma may be present. Type IV includes cases in which there are symptoms of intracranial complications or in which there is definite evidence of cholesteatoma.

Treatment of types I and II is conservative, including local antiseptics and powders (he found iodine powder to be as effective as sulfanilamide), minor operation to remove tonsils and adenoids or radiation to remove adenoid remnants. Type III may require mastoidectomy, and type IV always requires it.

Heatly [24] cautions that the marginal perforation, often concealed by a dry adherent crust, must be considered the most dangerous type because it indicates suppuration in the attic and a strong probability of cholesteatoma. He makes the same statement as Voorhees [18] and others, that roentgenologic examination is less informative in chronic suppuration than it is in acute otitis media.

Voorhees [25] (Irving Wilson) reports good results in the treatment of chronic otitis media in which cholesteatoma and necrosis of the bone are absent. He uses a fine copper or aluminum wire with a fused bead of chromic acid for removing granulations in the middle ear. After the granulations are gone, the removal sometimes requiring many visits, a powder is dusted in, containing iodine, potassium iodide and boric acid. He warns his patients that treatments may take months and will not start treatments until the patient agrees to a long series.

OTITIC MENINGITIS

The series reported by Commander Koebbe and Lieutenant Commander Potter [22] of 20 cases of meningitis developing in a period of

24. Heatly, C. A.: Chronic Diseases of the Nose, Throat and Ear, M. Clin. North America **28**:330-338 (March) 1944.

25. Voorhees, I. W.: Non-Surgical Treatment of Chronic Suppurative Otitis Media, Eye, Ear, Nose & Throat Monthly **23**:26-27 (Jan.) 1944.

six and one-half months is remarkable. Still more remarkable is their record of 100 per cent recoveries. A combination of the sulfonamide drugs and penicillin was used in treatment. [The authors state that in 7 out of 20 cases of meningitis virulent micro-organisms were grown from the spinal fluid. Presumably the spinal fluid in the other 13 cases was sterile. It has not been customary to report cases as those of true meningitis unless organisms were recovered from the spinal fluid. The authors still have 100 per cent of recovery for meningitis, but only on the basis of 7 cases.]

In most of their cases the aural infection had been present three to five weeks at the time meningitis developed. But in 4 cases the onset came in three to five days after the onset of otitis media.

The series of otitic meningitis reported by Williams [26] in 1942 showed a rise in the recovery rate from 35 to 69 per cent with the advent of sulfonamide drugs.

Dean [21] reports a death from meningitis developing one week after operation for chronic suppurative otitis media and extradural abscess. Chemotherapy was used, without success.

Sugar's [7] patient, a boy of 11, died of meningitis coming on after a radical mastoidectomy. The organism was B. proteus.

Moorhead [27] states that the onset of meningitis is frequently accompanied with vomiting and sudden onset of high temperature.

THROMBOSIS OF THE LATERAL SINUS

Commander Koebbe and Lieutenant Commander Potter [22] did not ligate the internal jugular vein in any of their 14 cases of thrombosis of the lateral sinus, and their recovery rate was 100 per cent.

In the series reported by Hartman and co-workers, the mortality rate dropped from between 25 and 35 per cent to 10 per cent with the use of sulfonamide drugs.

Major McKee's [6] patient with lateral sinus thrombosis caused by B. proteus infection recovered with administration of sulfapyridine and radical operation.

Lothrop [5] ligated the jugular vein in his case of lateral sinus thrombosis caused by B. proteus. Sulfapyridine in large doses was used. [It is possible that with the use of large amounts of penicillin in lateral sinus thrombosis ligation of the jugular vein may be unnecessary. However, occasional cases of sudden death from pulmonary embolism have been reported. Pulmonary abscess and empyema from smaller

26. Williams, H. L., and others: Otitic Meningitis, Laryngoscope **52**:835-869 (Nov.) 1942.

27. Moorhead, R. L.: Complications of Acute Mastoiditis, Pennsylvania M. J. **47**:431-439 (Feb.) 1944.

emboli certainly occur. Ligation of the jugular vein can do no harm when the circulation is already interrupted and protection from emboli may be afforded.]

Lillie [28] analyzes a series of 23 patients with suppurative labyrinthitis. Labyrinthotomy was done on 12 patients, and labyrinthectomy was done on 11. The former operation was done "when there is no evidence of extension of the disease beyond the confines of the otic capsule . . . labyrinthectomy . . . with purposeful wide exposure of the dura over the posterior and middle fossae . . . is indicated when there is evidence of extension of the infection beyond the confines of the otic capsule."

There were three deaths in the series of 12 cases in which labyrinthotomy was done and none in the 11 cases in which treatment was by labyrinthectomy. Lillie differentiates between cases in which the eighth nerve is destroyed by a petrositis and those in which there is definite infection of the labyrinth. The short duration, sometimes only a few hours, of the dizziness in the nerve involvement helps to set it apart from the prolonged symptoms in the cases of labyrinthine infection.

Temporary facial paralysis occurred in 5 cases. Injury of the dura with escape of spinal fluid was noted in 1 case without development of symptoms of meningitis. [This article deserves study by every otologist, especially the charts contrasting the symptoms of the two types of cases.]

Von Leden and Williams [29] report a case in which perforation of the horizontal semicircular canal produced labyrinthitis. The roentgenograms showed little evidence of infection on the diseased side and an apparent cholesteatoma on the normal side. Roentgenograms were repeated to make certain that the two sides were properly identified. A large cholesteatoma was found on the suspected side, which had eroded into the anterior part of the horizontal semicircular canal and produced a large fistula. The cholesteatoma was removed, but the fistula was not disturbed. Recovery was uneventful, and the vertigo disappeared in ten days.

Altmann and Waltner [30] report a series of 5 cases of labyrinthitis due to Pneumococcus type III in detail, with autopsy findings. There was a deep abscess of the posterior fossa present in each of the 5 cases.

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28. Lillie, H. I.: Critical Review of Patients Subjected to Labyrinth Operations, Ann. Otol., Rhin. & Laryng. **53**:207-220 (June) 1944.

29. Von Leden, H., and Williams, H. L.: Cholesteatoma with Fistula into the Labyrinth, Arch. Otolaryng. **39**:432-433 (May) 1944.

30. Altmann, F., and Waltner, J. G.: Labyrinthitis Due to Pneumococcus Type III, Arch. Otolaryng. **40**:75-92 (Aug.) 1944.

The characteristic picture in infections with the type III Pneumococcus is that of proliferation of the mucosa of the middle ear. There is early and pronounced proliferation of the connective tissue and only moderate swelling and hyperemia. Masses of new connective tissue fill out the recesses of the middle ear and surround the chain of ossicles. This not only causes the typical blocking off of drainage of the mastoid cells, with resulting abscess and necrosis, but also, in patients that recover, may cause the immobilization of the ossicles, producing conduction deafness. [This paper has excellent illustrations of the serial sections of the temporal bones, and the cases are carefully analyzed and compared with cases in other series of reports of labyrinthitis and meningitis due to Pneumococcus. The 5 cases reported by these authors are all described as cases of petrositis in which the mastoid operation did not drain the focus of suppuration in the perilabyrinthine cells. The real importance of this article is in that the undrained focus of suppuration in the petrosal cells (petrositis) was the cause of the fatal complication in these 5 cases. Such a focus is a common cause of labyrinthitis. The authors seem to recognize this in the last paragraph of their summary but fail to bring out this most important point.]

One case of labyrinthitis occurred in the series reported by Commander Koebbe and Lieutenant Commander Potter.[22] This was associated with acute pansinusitis and orbital edema and occurred during scarlet fever. Treatment was by intramuscular injection of penicillin until the acute phase was over; then mastoidectomy was performed. Loss of hearing was pronounced on recovery.

OTITIC ABSCESS OF THE BRAIN

Dean's [21] patient died suddenly when an encapsulated abscess of the brain ruptured. The abscess was secondary to cholesteatoma.

Wolfson [31] reports a case of a man of 56 in which iodized poppyseed oil instilled into a temperosphenoidal abscess demonstrated by roentgenogram that rupture into the lateral ventricle had occurred. The patient recovered after drainage of the abscess and with administration of large doses of sulfadiazine. No similar case was found in the literature. The patient had had chronic otitis media since childhood. The abscess of the brain had come on after an infection of the upper respiratory tract. He was admitted to the hospital with facial paralysis. Radical mastoidectomy was done, and five days later the hemiplegia developed

31. Wolfson, L. E.: Rupture of a Left Temperosphenoidal Abscess into the Ventricle: Report of a Case with Recovery, New England J. Med. **230**:170-171 (Feb. 10) 1944.

suddenly along with a sudden rise in temperature. The temperosphenoidal abscess was found and drained.

Weickhardt and Watts [32] report a fatal case of abscess of the medulla oblongata occurring in a man of 34. He had had an intermittent discharge from the ear since childhood. Symptoms of petrositis developed one month after a radical mastoidectomy. An exploratory operation was done, but nothing was found. He died shortly afterward. Autopsy revealed a definite abscess in the medulla oblongata. His search of the literature revealed 9 cases in all of which the abscesses were due to aural infections. All were fatal.

PETROSITIS

Eggston [33] reports 3 fatal cases of petrositis, with illustrations of sections made through the petrous pyramids. Two of the cases occurred before the sulfonamide compounds were available, and in the third, occurring in 1937, azosulfamide (disodium 4-sulfamidophenyl-2′-azo-7′-acetylamino-1′-hydroxynaphthalene-3′, 6′-disulfonate) only was administered. The author states that he had seen 2 other fatal cases of petrositis in which massive doses of sulfonamide drugs had been given, without success. Eggston mentions that it is not necessary that a petrous pyramid be pneumatized in order to become infected. He states that 20 per cent of specimens contain marrow, 35 per cent are pneumatized and the remaining 45 per cent show a mixture of marrow and cells. The pneumatized bones are more liable to be infected. He comments that "Every case of prolonged mastoiditis . . . should be carefully surveyed with petrositis in mind. It is frequently difficult or impossible to locate the infected area either at surgical exploration or at autopsy. This is particularly true if the dura is intact. Serial microscopic sections of the bone are necessary to find and properly evaluate a petrosal infection." This difficulty in locating the infection was shown in the third case, in which neither operation nor gross examination at autopsy revealed the infection. Serial sections of the petrous bone showed a definite abscess in the petrous apex, which caused the fatal basilar meningitis.

[Serial sections in petrositis of tympanic origin have consistently shown that the infection has had free entrance to the pyramid along pneumatized tracts. In the absence of such tracts the bone marrow of the pyramid is protected from infections of the middle ear by the dense bone of the labyrinthine capsule and carotid canal.]

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32. Weickhardt, G. D., and Watts, J. W.: Abscess of the Medulla Oblongata: Report of Case, Arch. Neurol. & Psychiat. **51**:282-284 (March) 1944.

33. Eggston, A. A.: Pathology of Petrositis: Report of Three Cases, Arch. Otolaryng. **39**:421-429 (May) 1944.

Lindsay [2] reviews the anatomy of the petrous tip. In 35 per cent of the petrous bones there is pneumatization in the perilabyrinthine region, and in about 20 per cent there is pneumatization of the apex. Petrositis may be posterior or anterior, depending on the route of pneumatization. The posterior type may be drained by a posterior approach after simple mastoidectomy, while the anterior type may require an approach through the middle ear after preliminary radical mastoidectomy.

Moorhead [27] states that petrositis is indicated by paralysis of the sixth nerve, and the longer the interval between simple mastoidectomy and the onset of the petrositis symptoms, the more likely will petrous operation be necessary.

Pastore and Meredith [34] report an interesting case of a woman of 26 who was admitted with a discharging sinus of the left occipital region of seven months' duration. She had had an intermittent left-sided headache for three years. She had had otitis media three years before. Mastoiditis and petrositis developed and were later followed by two attacks of labyrinthitis. A simple mastoidectomy was done two years after the onset of symptoms, and a fistula from an extradural abscess developed in the left occipital region a few weeks later. This drained intermittently. When the drainage was occurring the patient had no headache, and when the drainage stopped the headache recurred. Labyrinthectomy was done, and sequestrums were removed from the petrous pyramid. There was not noted at any time the usual postocular pain associated with petrositis. The spontaneous drainage from the petrous pyramid and extradural abscess escaped through the lambdoidal suture.

Pennybacker [35] reports 3 cases of cholesteatoma of the petrous bone, with gradual facial paralysis. The roentgenogram showed erosion of the petrous bone in each case. Operations showed cholesteatoma. There was no death. One patient recovered facial motion almost completely after operation. Pennybacker found that 11 similar cases had been reported.

FACIAL PARALYSIS AND OTITIS MEDIA

Decker [36] reviews 400 cases of facial paralysis occurring in a general hospital and reports 15 per cent to be associated with otitis media. Eight per cent were in acute and 7 per cent in chronic otitis media.

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34. Pastore, P. N., and Meredith, J. M.: Chronic Osteomyelitis of the Petrous Pyramid with Extensive Extradural Abscess and Spontaneous Decompression, Virginia M. Monthly **71**:149-153 (March) 1944.

35. Pennybacker, J.: Cholesteatoma of the Petrous Bone, Brit. J. Surg. **32**: 75-78 (July) 1944.

36. Decker, R. M.: Facial Paralysis Associated with Otitis Media, Laryngoscope **54**:186-189 (April) 1944.

He concludes that paralysis occurring in the first few days of acute otitis media is not an indication for mastoidectomy, but if it occurs after ten days or more it is probably associated with necrosis and operation should be done. Paralysis in chronic otitis is a definite indication for immediate operation.

Tschiassny [37] reviews the literature on acute otitis media associated with facial paralysis. He found differences of opinion; some authorities advised immediate operation even in the first days of acute otitis media if facial paralysis occurred.

He suggested that daily examination with faradic current be done, and if even a slight reaction of degeneration should be noticed this would be an indication for mastoidectomy, without waiting for signs of mastoiditis. [This test should be tried out in a large number of cases before acceptance.]

MISCELLANEOUS

Schugt [38] reports 2 cases of mastoiditis in which there was severe pain referred to the chest and upper part of the arms and in 1 case to the face. The pathways involved are the autonomic nerves which extend along the carotid arteries.

Moulden [39] reports a fatal hemorrhage following radical mastoidectomy. Symptoms of cerebral compression were noticed in the second postoperative day. The patient became comatose within two hours after onset of symptoms. Bleeding had occurred from the inferior petrosal sinus but did not show on the dressing, because of a tight petrolatum gauze pack. Hematoma had stripped up the dura of the middle fossa in the temperoparietal area in which the dura had been exposed. The patient died as the clot was being removed. The author advised that in cases in which there has been an exposure of the dura and tight packing is to be used a short rubber tube drain should be inserted in the region of the dura.

65 North Madison Avenue.

37. Tschiassny, K.: Is Facial Palsy, When Complicating a Case of Acute Otitis Media, Indicative for Immediate Operation? Cincinnati J. Med. **25**:262-266 (Aug.) 1944.

38. Schugt, H. P.: Pain Referred to Face, Neck, Upper Extremity and Chest Due to Lesions in the Ear, Arch. Otolaryng. **39**:430-431 (May) 1944.

39. Moulden, G. A.: A Case of Extra-Dural Hemorrhage from the Inferior Petrosal Sinus Following Mastoidectomy, J. Laryng. & Otol. **58**:376-378 (Sept.) 1943.

News and Comment

FIRST PAN-AMERICAN CONGRESS OF OTORHINOLARYNGOLOGY AND BRONCHO-ESOPHAGOLOGY

A meeting of the Pan-American Congress of Otorhinolaryngology and Broncho-esophagology will be held in Chicago in October 1946, sponsored by the American Academy of Ophthalmology and Otolaryngology, with the cooperation of the societies of otorhinolaryngology of the other American republics and Canada. This meeting will follow immediately after, and overlap, the annual meeting of the American Academy of Ophthalmology and Otolaryngology. Those attending the Pan-American Congress from other countries will be invited to participate as guests in the scientific and social activities of the meeting of the Academy. All otorhinolaryngologists of good standing in North, Central and South America and the West Indies are invited to attend.

Transportation and Hotel Accommodations; Registration.—The Pan-American Airways and connecting railways, as well as railroad and steamship lines, will be requested to allow discounts on fares for those attending the Congress.

Every effort will be made to secure hotel accommodations in Chicago, provided reservations are made long enough in advance.

The registration fee for Pan-American Congress will be $5.

Those wishing to attend the Congress are requested to communicate immediately with the Secretary. Titles for papers or motion picture films in any of the four official languages, Spanish, Portuguese, French and English, are solicited by the program committee.

CHEVALIER L. JACKSON, Secretary,
Pan-American Congress of Oto-Rhino-Laryngology
and Broncho-Esophagology
255 South 17th Street
Philadelphia 3, Pa., U. S. A.

ALUMNI MEETING OF NEW YORK EYE AND EAR INFIRMARY

The first alumni meeting of the New York Eye and Ear Infirmary since the war will be held at 9:00 a. m., Sept. 7, 1946, at the New York Eye and Ear Infirmary, to be followed by a dinner at the University Club the same evening.

Communications should be addressed to B. F. Payne, M.D., acting secretary-treasurer, New York Eye and Ear Infirmary, 218 Second Avenue, New York 3.

EXAMINATION FOR CERTIFICATION OF SPECIALISTS

The America Board of Otolaryngology will conduct an examination in Chicago at the Palmer House on Oct. 8 to 12, 1946.

Abstracts from Current Literature

Ear

REFLECTIONS ON THE RADICAL MASTOID OPERATION. B. SEYMOUR JONES, J. Laryng. & Otol. **60**:233 (June) 1945.

In this essay the author describes his personal experience and his technic in performing radical mastoidectomy at the Birmingham and Midland Ear, Nose and Throat Hospital, in England. He describes an ingenious upper meatal flap whereby the skin of the external auditory canal is turned to cover the roof of the cavity left after the mastoidectomy. In addition, he turns a periosteal flap from the cortex of the mastoid process into the excavated groove of the mastoid tip in an effort to provide a better bed for epithelization. He discusses his experience with the use of the skin graft in the cavity in the care of the radical mastoidectomy wound, in variations of the radical mastoidectomy and finally in the after-treatment of the cavity. He stresses the fact that the surgeon himself must perform all dressings and make the appropriate "toilette" for each individual cavity. This personal supervision has enabled him to surmount all obstacles and obtain a finished result in 95 per cent of his cases.

[Comment: Dr. Jones's upper meatal flap has considerable merit, and a modification of it may be of value in all types of endaural surgical procedure by preventing the annoying granulation tissue which frequently occurs on the roof of endaural cavities. Dr. Jones states that there is a modern trend of opinion in favor of conserving the ossicles. Certainly this British trend is the exact opposite of our tendency toward eradicating all disease in the tympanum and the hypotympanum.]

LEJEUNE and FARRIOR, New Orleans.

THE MASKING EFFECT OF SULFONAMIDE WHEN USED IN THE TREATMENT OF ACUTE OTITIS MEDIA. I. MALCOLM FARQUHARSON, J. Laryng. & Otol. **60**:269 (July) 1945.

Farquharson compares the incidence and the symptoms of mastoiditis in patients who had acute suppurative otitis media and who were treated before sulfonamide compounds came into use with the incidence and the symptoms of mastoiditis in those who received sulfonamide compounds in treatment of suppurative otitis media at the Royal Infirmary in Edinburgh, Scotland. He reports that the incidence of surgical mastoiditis was reduced from 29 to 13 per cent by the use of sulfonamide drugs. He presents a series of illustrative cases with comment. He describes adequately the clinical characteristics of the "masked mastoiditis," stating that the exhibition of a sulfonamide compound is liable to change the ordinary infection of this type into one which is identical with that produced by pneumococci of type III.

He rightly calls attention to the increased incidence of deafness following treatment of otitis media with sulfonamide drugs and to the increasing incidence of chronic suppurative otitis media in patients treated with sulfonamide compounds.

In the discussion on this article, varied opinions are presented about the use of sulfonamide drugs in acute suppurative otitis media. Farquharson states that the sulfonamide drugs should be withheld in certain cases because their effect masks complications. We differ in regard to this, believing that sulfonamide drugs (and penicillin) must be given to control these complications and that the detection of the latter must rest with the diagnostic acumen of the otologist.

LEJEUNE and FARRIOR, New Orleans.

THROMBOPHLEBITIS OF THE LATERAL SINUS. GEORGE OTTE, Rev. de otorrinolaring. **5**:173 (Dec.) 1945.

In evaluating thrombophlebitis, Otte states that this is one of the most frequent complications of cases of suppurative otitis media. He believes that its incidence is not influenced by any trauma of mastoidectomy, an opinion contrary to certain views advanced by other authors. In a group of 100 cases in which the lateral sinus was exposed during operation, he has not in a single case observed subsequent thrombophlebitis, provided frank injury of the vessel had not occurred or the vessel was not previously infected. The symptom complex is usually that of high temperature, with daily remissions, and chills. On the other hand, the patient presents a good general state of health; headaches, mental confusion and other intracranial signs usually are absent, provided there is no associated labyrinthine or meningeal involvement. If intracranial symptoms appear, and one suspects thrombophlebitis, they are an indication of further intracranial complications, most commonly cerebral abscess.

The author discusses the relative merits of ligating the internal jugular vein in a surgical procedure. Personally he prefers ligation, but he believes that in the future, owing to the use of penicillin and other chemotherapeutic agents, this form of surgical intervention may be unnecessary. He presents 2 patients who had a typical form of thrombophlebitis and who were treated intensively with sulfonamide compounds without improvement, for whom it was necessary to perform ligation of the internal jugular vein. One of the side effects of ligation of this vein is intracranial venous stasis, which occurred in one of his patients, with typical hemiplegia, headache, vomiting and facial paralysis. A diagnosis of cerebral abscess was made, and an exploratory puncture was performed both in the cerebrum and in the cerebellum, but the abscess was not found. Subsequent to this, however, the patient made an uneventful spontaneous recovery. Otte presents 3 other patients who had a typical form of thrombophlebitis. Two of them had associated cerebral abscess, and in these the clinical manifestations of thrombophlebitis were definitely obscured by the intracranial symptoms; in the third, ligation of the internal jugular vein was performed, and massive doses of penicillin were administered, but the meningeal symptoms continued, and the patient died. Autopsy revealed tuberculous meningitis. Otte believes that thrombophlebitis is more frequently associated with mastoiditis of the left side and that in consequence the further complication of a cerebellar abscess of that side is more common. On the other hand, if the right mastoid process is involved, there is a greater frequency of cerebral abscess. Therapeutically he believes that the following routine should be enforced: 1. There must be thorough exenteration of the mastoid cells with all diseased tissue and wide exposure of the infected sinus. 2. This is to be supplemented with intensive penicillin therapy. 3. If a septic picture persists, ligation of the jugular vein is indicated. If the bulb of the jugular vein is thrombosed, he advises that it be resected according to the Ramadier technic.

PERSKY, Philadelphia.

SWIMMER'S OTITIS: ETIOLOGY, SYMPTOMATOLOGY AND PATHOGENESIS. J. C. NIELSEN, Acta oto-laryng. **33**:31 (Jan.-Feb.) 1945.

Nielsen's view of the etiologic factors and the pathogenesis of bather's otitis is different from that which has hitherto been prevalent. He bases his theory on the examination of two series of cases, one during the summer of 1941 and one during the summer of 1943. In 1941 he examined bacteriologically 33 cases and came to the conclusion that about 90 per cent of the otitides were caused by pneumococci, that the infections were endogenous, arising from certain nasopharyngeal bacteria, and that impure bathing water played no etiologic role. As these conclusions were not in accord with the previously accepted view, he examined a further series of 20 cases during the summer of 1943.

Regarding the etiologic factors, Buchband in 1939 reported on 20 cases of mastoiditis. In 50 per cent the infecting organisms were hemolytic streptococci,

in 28 per cent pneumococci and in 14 per cent anhemolytic streptococci. In these cases the involvement was particularly severe, with a mortality rate of 12.5 per cent. In 1939 Kettel reported on 23 cases of swimmer's otitis, in 92 per cent of which he isolated either Bacillus coli or staphylococci or both from the ear and the nasopharynx. Mastoiditis occurred in 4 per cent.

Nielsen calls attention to Taylor's observations on the fall of body temperature in swimmers and to the fact that water forced through the nose into the nasopharynx washes away the protective layer of mucus over the cilia of the nasal mucosa and thus retards or completely abolishes ciliary activity. Damage to such a mucosa was demonstrated microscopically by David Mezz in 1940.

Nielsen's technic in his 1943 series was that of aspirating the tympanic secretion after myringotomy, thus avoiding the contaminating flora of the external auditory canal. In all 20 cases pure cultures of pneumococci were obtained. Of these, 65 per cent were type I, 15 per cent type II and 20 per cent type III. In his 1941 series types V, III, I and XXVII were noted. His patients were predominantly young males, which corresponds to the finding of Buchband. He seeks to explain this by the fact that the adipose layer of the female, being heavier than that of the male, protects her better against a fall of body temperature.

The symptoms observed were mild and ran an average course of ten days. Rhinopharyngitis was present in only 20 per cent of the cases. All of the patients had indulged in diving.

As bacteriologic examination of the water of Copenhagen swimming pools showed no pneumococci, Nielsen discards the thesis that impure water is an etiologic factor. He believes that the infection occurs by way of the eustachian tube and explains the fact that it was a pure pneumococcic infection and not a mixed infection by supposing that the pneumococci in the nasopharynx are especially susceptible to the effects of general and local reduction in body temperature.

GROVE, Milwaukee.

HEARING DEFECT CAUSED BY OSTEITIS DEFORMANS. EDMUND MÉSZÖLY, Acta oto-laryng. **33**:117 (Jan.-Feb.) 1945.

Paget's disease, a rare condition which is tied up with faulty function of the glands of internal secretion, is a progressive condition in which softening of bone, change of form of bone and new bone formation occur in certain areas of predilection. Most of the patients whose cases have been reported in the literature were older persons, although the disease has been reported in 2 patients aged 13 and 16. It is more prevalent in females. It affects both the long and the flat bones and is particularly prone to involve the skull. The bones become soft and bend, and a torsion of the long axis of the pyramid takes place, with consequent twisting of the eighth nerve and the internal auditory artery.

The eighth nerve degeneration is caused by the mechanical pressure due to a narrowing of the canals and hollow spaces in which the nerve is located. The external canal may be greatly narrowed or even completely closed by exostoses. The original bone tissue is absorbed and replaced by new bone which has no calcium content. Such bone changes occurring in the cochlea and the vestibule are particularly characteristic. The nerves and ganglion cells become highly atrophied. The lumens of the semicircular canals, of the utricle and of the sacculus are greatly narrowed. The roentgen picture is quite characteristic, showing areas of softening, changes of form in the bone and exostoses.

The general symptoms are not characteristic. There may be no headache in some cases. In others there is headache of varying degrees of intensity. Some patients have severe vertigo; others, none. The most characteristic symptom is gradual loss of hearing of varying grades up to complete deafness. Depending on the location of the bony lesion, this can be conductive or perceptive in type.

Mészöly reports the case of a 67 year old woman whose disease began in 1933 with a painful bony swelling of the left canine fossa. Later, both cheeks began to swell, and headaches set in. At that time roentgenograms revealed that the

bones of the vault were much thickened and contained calcareous islands, between which were areas of cystlike cavities. The base of the skull was sclerotic and eburnated. The maxillary sinuses were much narrowed. The cells of the ethmoid bone were completely eburnated. The maxilla was deformed.

In 1936 the hearing began to fall off. This was at that time due to a lesion of the conductive apparatus. The drum membrane was normal, as was bone conduction, but the hearing was reduced, the audiogram presenting a flat type curve. Mészöly saw the patient for the first time on Nov. 7, 1941. In the interim the hearing had fallen from 2 meters on the right and 1 meter on the left side to 25 cm. on each side for the low voice. Hearing for the low and the high tones was completely gone, and bone conduction was shortened. The labyrinths were marked by hypoirritability to caloric stimulation. By Jan. 6, 1943 she could not hear a low conversational voice on the right side and could hear it only if it was within 10 cm. on the left side.

GROVE, Milwaukee.

Pharynx

THE CLOSURE OF OROMAXILLARY FISTULAE—A PRELIMINARY REPORT. BRUCE PROCTOR, Laryngoscope **56**:46 (Feb.) 1946.

Many methods of closing an oromaxillary fistula have been difficult to perform and have at times given poor results. Proctor cleans out the fistula and prepares a cone-shaped cartilage graft, which he wedges into the opening. His results have been good.

HITSCHLER, Philadelphia.

CONGENITAL CYSTS OF THE ŒSOPHAGUS. S. RANSTRÖM, Acta oto-laryng. **33**:486, 1945.

Two cases of congenital esophageal cysts are described. In both cases the cysts lay in the upper half of the esophagus. In both, the cyst walls were composed of a partly ciliated columnar cell epithelium, a tunica muscularis mucosae, a submucous connective tissue and a muscular wall of smooth musculature in two layers, with the fibers at right angles to one another. These cysts may be considered to have developed from persisting vacuoles which were surrounded by and detached from the esophageal epithelium. Such vacuoles are a normal occurrence during the second fetal month.

KETTEL, Hilleröd, Denmark.

Larynx

BRONCHOGENIC CARCINOMA—DIAGNOSIS BY CYTOLOGIC STUDY OF BRONCHOSCOPICALLY REMOVED SECRETIONS. PETER A. HERBUT and LOUIS H. CLERF, J. A. M. A. **130**:1006 (April 13) 1946.

Herbut and Clerf write convincingly of the diagnostic value of bronchoscopically removed secretions.

In 30 consecutive cases of primary carcinoma, bronchial secretions were stained by the Papanicolaou technic; cancer cells were demonstrated in 22 cases, or 73 per cent. However, it is quite necessary to make a complete study of the normal flora of bronchial secretions before attempting to read the abnormal.

In the same series a positive diagnosis was obtained with biopsy of tissue removed endoscopically in 11 cases, or 36 per cent. Cancer cells were present in the secretions from 7 patients in whom bronchoscopy revealed nothing abnormal.

Sputums were examined in 5 cases in which cancer cells were present in bronchial secretions, and in only 1 of these were neoplastic cells found.

A few pertinent cytologic findings are: 1. The most frequent variety of primary tumor of the bronchus is squamous cell carcinoma, and it is easy to recognize in bronchial secretions. 2. Any group of cells bearing cilia are not cancerous. 3. When bizarre single cells are found there is no question of the process being cancerous.

Cytologic study of bronchial secretions would add to the means already employed in the diagnosis of pulmonary carcinoma, especially when the lesion is in the periphery or in the upper lobe of the lung. LIEBERMAN, Philadelphia.

SOME OBSERVATIONS ON THE ETIOLOGY OF FOREIGN BODIES IN THE ESOPHAGUS. PHILIP READING, J. Laryng. & Otol. **60**:246 (June) 1945.

Of 114 esophagoscopic examinations for suspected foreign bodies, 84 revealed esophageal foreign bodies. No complications or deaths occurred in the series reported. Thirty-three of the patients were children under 13 years of age, while 51 were persons over this age. As to the foreign bodies found in children, coins were the objects in 29 instances while meat bone, toy soldier, curtain ring and jackstone are listed in single cases. Of those found in adults, meat bone and meat bolus were found in 45 instances, while coin, safety pin, needle, beer bottle cap, brooch and denture are listed in single instances.

The author states that the etiologic explanation of esophageal foreign body falls into one of three categories in his cases: 1. The patient knew the foreign body was present in his mouth and swallowed it by accident. 2. The patient deliberately swallowed a foreign body. 3. The patient swallowed a foreign body because he did not know that it was in his mouth. Reading expresses the opinion that the presence of upper dentures greatly enhances the possibility of swallowing a foreign body, as in this series upper dentures were worn by 39 of 40 patients who swallowed bones. LEJEUNE and STEELE, New Orleans.

Nose

LOW-VOLTAGE GALVANIZATION IN SINUSITIS. E. KUPFER, J. Laryng. & Otol. **60**:68 (Feb.) 1945.

This article continues a report on otitic galvanotherapy published by the author in 1934.

The apparatus, which comprises (1) a grid bias battery of 16.5 volts in steps of 1.5 volts, (2) a milliamperemeter, (3) a potentiometer and (4) three metallic alloy electrodes, is described in detail. The technic of applying the electrodes and carrying out the treatment is given. It is stated that the first two treatments should be on successive days and that subsequent treatments should take place at intervals of forty-eight to seventy-two hours. The optimum voltage is reported to be between 9 and 13 volts for acute sinus infections; for chronic or refractory conditions it is slightly higher, and continuance of treatment is necessary.

Eight cases are reported in detail. Suggestions as to the manner in which galvanization effects relief in sinusitis are submitted.

LEJEUNE and STEELE, New Orleans.

THE ROENTGEN TREATMENT OF VASOMOTOR RHINITIS. ALEX RENANDER, Acta oto-laryng. **33**:44 (Jan.-Feb.) 1945.

Renander reports on 226 patients with vasomotor rhinitis who were treated by irradiation during the years 1938 to 1941. No other form of therapy was used. The diagnosis was made by a rhinologist who referred each patient to Renander for treatment. There were only slightly more males than females in the series. In 95 patients (42 per cent) sinus changes which Renander classified as sinusitis were found by roentgen examination. In 43 patients (19 per cent) the rhinitis was complicated with asthma. In 23 patients (10 per cent) the condition was complicated by both sinusitis and asthma. In only 11, or 5 per cent, was the rhinitis complicated by polyposis.

Of the entire series of 226 patients, 221 were checked later. Of these, 149 (67 per cent) had obtained complete relief, 50 (23 per cent) improvement and

22 (10 per cent) no change. The improvement lasted less than one year in 56 per cent and less than two years in 41 per cent.

After experimentation with the dosage, Renander decided that three treatments with 100 to 150 r each of the region of the nose and the sinuses (the eyes being covered) constituted the minimum with which good results could be achieved. The interval between treatment was one to two days. The results obtained were not any worse when the vasomotor rhinitis was complicated by asthma and sinusitis.

GROVE, Milwaukee.

Miscellaneous

THE RHEUMATIC FEVER PROBLEM. CHARLES F. COBURN, Am. J. Dis. Child. **70**:348 (Nov.-Dec.) 1945.

Coburn is one of the few students of rheumatic fever who has stressed hemolytic streptococcus infections of the nose and the throat as a competent cause. During World War II the United States Navy set up a special plan of study, the results of which are reported in part in two articles in the *American Journal of Diseases of Children*. Article I covers the present status of the rheumatic fever problem. Article II is concerned with "Approaches Awaiting Development." Otolaryngologists will profit by reading the entire report, but especially will they be interested in the "hemolytic streptococcus infection which precedes rheumatic fever." This may be "mild and nonsuppurative," with seemingly prompt recovery. There seems to be a special strain which inhabits the nasopharynx and the tonsils or perhaps any other lymphoid "nest." This strain may be disseminated and may be contagious. Certain persons become carriers without marked symptoms, and they are the dangerous ones. They may show only mild sinusitis, but unless these discharges can be suppressed or rendered innocuous, endemic outbreaks may be expected. It is suggested that "antivitamins" be developed "which will compete successfully with . . . factors essential for survival of the streptococcus cell." There is, of course, much more to the problem than that, for it involves immunologic, serologic, bacteriologic and biochemical factors and metabolism. However, the nasopharyngeal portals of entry have not been as yet sufficiently studied. Here is a great opportunity for some youthful enthusiast to render a great service.

VOORHEES, New York.

A REVIEW OF TUBERCULOSIS IN THE FIELD OF OTOLARYNGOLOGY FOR LATE 1944 AND EARLY 1945. FRANK R. SPENCER, Laryngoscope **55**:673 (Dec.) 1945.

Rubin feels that it is difficult to diagnose early tuberculous otitis and suggests withdrawal of pus from the middle ear. The pus of tuberculosis will give a positive result on animal inoculation.

The treatment of tuberculosis with streptomycin has been fairly satisfactory, although much more work will have to be done before its merits can be accurately evaluated.

A case of tuberculosis of the mastoid process without pulmonary involvement is presented. Tuberculous lesions of the larynx and the pharynx are most frequently secondary to active pulmonary involvement. HITSCHLER, Philadelphia.

BIOLOGICAL INVESTIGATION OF A NEW ABSORBABLE SPONGE. J. T. CORRELL, H. R. PRENTICE and E. C. WISE, Surg., Gynec. & Obst. **81**:585 (Nov.) 1945.

A sponge with a water-insoluble base is described by Correll and his co-workers as satisfying the requirements of an absorbable matrix. Based on the knowledge that catgut undergoes enzymatic digestion in vitro, experiments were carried out with gelatin sponge, which demonstrated that there is in vitro digestion in a pepsin solution. Implants of fibrin foam, starch sponge and gelatin sponge were made in rat muscle and examined in microscopic sections at varying periods. Gelatin sponges soaked in penicillin solution were readily absorbed. Thrombin-moist

gelatin implants were absorbed by the thirtieth day without any appearance of encapsulation. Fibrin foam was not completely absorbed by the hundredth day. Starch sponges were not visible on the fiftieth day. The only reaction to gelatin sponges was cellular infiltration, similar to that seen in blood clot, which reached a maxmium about the twenty-fifth day and then gradually regressed.

SELTZER, Philadelphia.

BRONCHITIS CIRCUMSCRIPTA NON SPECIFICA. TRULS LEEGAARD, Acta oto-laryng. **33**:391, 1945.

The histories of 6 cases of a condition which is designated bronchitis circumscripta non specifica are related. The most important symptoms were cough, hemoptysis and signs of bronchostenosis. Locally there were circumscribed involvements of the mucous membrane of the larger bronchi, with rubor and edema and sometimes considerable granulation. In 2 cases this led to atelectasis of one lobe of the involved lung.

The condition is supposed to arise as a result of acute catarrhal infection of the mucous membrane and to be of frequent occurrence. In most cases it disappears spontaneously. It may evoke secondary changes in the lungs, with development of bronchiectasis.

It is of importance to know that grave symptoms, such as persistent cough, hemoptysis and signs of bronchostenosis, may be evoked by a nonspecific inflammation.

KETTEL, Hilleröd, Denmark.

COMPLICATIONS IN THE EAR, NOSE AND THROAT IN INFECTIOUS MONONUCLEOSIS. ELMAR BERG, Acta oto-laryng. **33**:454, 1945.

Otolaryngologic complications are more frequent in cases of infectious mononucleosis than is suggested by a review of the literature. They are due to secondary infections involving in particular the nose, the nasopharynx, the sinuses and the middle ear. Peritonsillar infection is relatively less frequent. As a rule, the complications are benign, but sinusitis and otitis media prolong the period of illness. For avoidance of such complications, a prophylactic local treatment of rhinitis is suggested.

KETTEL, Hilleröd, Denmark.

Society Transactions

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

John F. Delph, M.D., President

Walter H. Theobald, M.D., Secretary

Regular Monthly Meeting, Dec. 3, 1945

Sulfonamide Toxicity: Interpretation of Laboratory Findings. Presented by Dr. I. Davidsohn.

Laboratory tests properly interpreted may help in the avoidance of serious complications in the course of sulfonamide therapy: The finding of sulfonamide crystals in the urine is of little consequence. Microscopic hematuria should focus attention on the adequacy of fluid intake and output, and on other possible impending complications, but does not of itself require interruption of therapy.

In the presence of gross hematuria, sulfonamide therapy should be stopped immediately.

The chemical reaction of the urine should be watched in patients receiving alkalis.

Blood counts and differential studies should be made at reasonable intervals. A blood count prior to initiation of therapy may help to evaluate subsequent findings.

Leukopenia is not a contraindication to sulfonamide therapy, nor is a leukopenia down to about 3,500 white blood cells when it develops in the course of treatment. Severe granulopenia is an absolute indication for immediate cessation of treatment with the compound used. Another sulfonamide compound may be tried with caution. Acute hemolytic anemia demands immediate cessation of sulfonamide therapy. Equally serious is thrombopenia.

Recent reports have shown that acute periarteritis nodosa may occur in the course of sulfonamide therapy. This complication is commoner if a horse immune serum is administered simultaneously, especially if serum disease develops.

DISCUSSION

Dr. Otto Saphir: In glancing at the tables Dr. Davidsohn has presented, one is struck by the multitude of findings made at postmortem examination and during clinical and laboratory examination in patients who have received the various sulfonamide compounds. Undoubtedly such a table should make the clinician afraid to use sulfonamide drugs.

What may one find in patients who come to postmortem examination, dying as the result of sulfonamide treatment? There are three factors which should be taken into consideration. First, there are patients who have an idiosyncrasy for sulfonamide drugs in general. Such patients may show reactions during the first treatment and after the first doses of sulfonamide drugs. Others gradually become sensitized to sulfonamide drugs. This one will see more and more because, as you know, during the last few years, after any operation the field has been sprinkled with sulfadiazine or other sulfonamide drugs. What is found in such cases? Principally, what is called hyperergic inflammation, particularly accentuated in the region of joints. One might find this in the region of the blood vessels in the form of a typical periarteritis nodosa. The patient may die as the result of diffuse periarteritis nodosa, particularly if the disease involves the myocardium.

The second factor to be considered is poisoning with sulfonamide drugs, seen in patients who die after having received large amounts. In such patients various

changes are seen in the hemopoietic system, as Dr. Davidsohn mentioned, and severe changes in the liver in the form of acute hepatitis, or rather a toxic necrosis. Severe damage is seen in the kidney with blockage of the tubules by the sulfonamide drug, which can actually be demonstrated under the microscope. Hemorrhages in the pelvis are common.

As an illustration of the third factor, I should like to mention three types of cases. A patient who had an infection of the upper respiratory tract had routinely received sulfonamide drugs. He experienced what was clinically called acute rheumatic fever, with increased temperature, increase in sedimentation rate, pains referable to the joints and swelling of joints. He died of bronchopneumonia. At necropsy no evidence of rheumatic fever was found; all the symptoms thought to be the result of rheumatic fever were the result of sulfonamide medication.

A second patient also received sulfonamide drugs for an infection of the upper respiratory tract. He experienced what was diagnosed clinically as acute hemorrhagic glomerulonephritis. Red blood corpuscles and casts were found in the urine; the level of nonprotein nitrogen in the blood gradually became elevated, and he died from what was thought to be acute hemorrhagic nephritis. Necropsy disclosed that the patient did not have acute hemorrhagic nephritis, but died of sulfonamide drug poisoning. It is sometimes very difficult to differentiate between acute hemorrhagic glomerulonephritis and renal changes due to poisoning with sulfonamide drugs. These 2 cases show that the sulfonamide drugs may mask the clinical symptoms and lead to an erroneous diagnosis. Such cases are becoming more and more frequent.

There are other cases, particularly in children who have an infection of the upper respiratory tract. The physician may prescribe some sulfonamide medication by telephone. The child is all right until he has an earache. The specialist is now consulted and makes a diagnosis of otitis media and says, "Before doing a paracentesis, let us wait and see what the sulfonamide drug will do." The otitis media seemingly clears up miraculously, and the paracentesis is not done. Although the otitis media has apparently cleared, the child suddenly has symptoms of acute meningitis or cerebral abscess. I have seen such cases, and I believe that if sulfonamide drugs had not been used the otitis media would have been treated by paracentesis, and the complication would not have occurred. It is true that many less operations are performed for mastoiditis than before the era of sulfonamide medication, but the fatal complication of abscess in the brain and meningitis still occurs, perhaps more so than before the advent of sulfonamide treatment.

Sulfonamide drugs should not be used indiscriminately. They should be prescribed only when other therapy fails. Of course, I speak from the point of view of a pathologist who is never asked to prescribe for an acute infectious disease.

Dr. Thomas C. Galloway: Masking of symptoms with sulfonamide compounds should not cloud the diagnosis if allowance is made for the effects of the drug. Because of sulfonamide drugs pediatricians have fewer and fewer ears operated on. I think that there can be much impairment of hearing resulting from organization of exudate left after the infection has subsided. I have seen several such cases, and Dr. Wishard mentioned it last year at the meeting of the Trilogical Society. When a child has a frank suppurative otitis media, opening and drainage are necessary to prevent this and other possible complications.

I should like to ask whether sulfonamide fastness is due to inadequate dosage or to the fact that sulfonamide compounds were given previously.

Dr. Walter Theobald: I doubt if we, as otologists, are as great offenders in the indiscriminate prescribing of sulfonamide drugs as the family physician who is called on to make a diagnosis and prescribe treatment, often by telephone. Some sulfonamide preparation is on the bathroom shelf, and any one in the household who has elevation of temperature resorts to the bottle; the drug is

used as freely as salicylates. I have observed patients with recurrent colds, recurrent infections, and have wondered why they were so nonresistant to the common cold. Many times when such a case is studied hematologically a low leukocyte count and marked hemolytic anemia are found.

There is another group on which I should like to have Dr. Davidsohn comment; these are patients who have been under sulfonamide therapy for some time and do not get over the effect; they have malaise, are below par, tired and fatigued—not for a few days but for weeks. Would this present pathologic evidence to you?

DR. SAMUEL SALINGER: Dr. Saphir mentioned the delayed or masked effect of sulfonamide compounds, which brings to mind two clinical items I have encountered which I think worthy of consideration. The first has to do with nausea and vomiting following an operation performed under local anesthesia when sulfonamide drugs had been given. It is difficult to determine whether this reaction is due to the drug or is the result of other factors such as the withholding of fluids for twelve hours prior to operation, plus the effect of morphine and barbiturates usually administered in these cases. Our patients are given sulfonamide drugs for forty-eight hours following operation for nasal conditions. It has been my observation that at least 25 per cent of these patients have pronounced nausea and vomiting which we have routinely attributed to the sulfonamide compounds. It has occurred to me recently that it might be due to withdrawal of fluids as well as to the reaction from the barbiturates and the sulfonamide drugs. It is true that in most cases nausea and vomiting cease when the sulfonamide drugs are withdrawn, yet in some cases nausea has persisted.

The second observation should be of interest to men doing rhinoplasty. Before sulfonamide drugs were given routinely we had a certain percentage of infection—in close to 10 per cent of all cases. Since we have given sulfadiazine for forty-eight hours following operation we find the percentage of infection greatly reduced, but we are encountering a few cases of delayed infection. Infection used to develop within forty-eight hours; now we send the patients home in good condition only to find that a certain number experience delayed infection a week or ten days later. This would seem to indicate that the sulfonamide drugs in some cases merely retard the activity of the bacteria which come to life after the withdrawal of the drug. It has been my observation that these cases of delayed infection are more serious than those which develop early because they result in more fibrosis and thickening. One is forced to conclude that either the drug should not be given at all, or else its administration must be continued for a longer period of time which, of course, means taking additional risks from the drug itself.

DR. I. DAVIDSOHN: I limited myself to the interpretation of laboratory findings, and did not mean to warn you against the use of sulfonamide drugs. I am trying to help you draw conclusions from what is found in the laboratory so that you may use the laboratory findings as a means of forestalling some ill effects. It is one thing to order laboratory tests and another to interpret them properly; they are of no advantage if not properly interpreted. I have read reports of serious complications following the use of sulfonamide drugs; some of the cases were thoroughly studied with all possible tests, but in many the proper conclusions were not drawn. For that reason I say that correct interpretation is fully as important as correct performance of laboratory tests.

Regarding periarteritis nodosa following sulfonamide therapy, Rich showed that the drug is just one factor. He was able to produce periarteritis nodosa in rabbits treated by horse serum without sulfonamide drugs. Hence the combined use of horse serum or horse immune serum with sulfonamide drugs is more dangerous than are the sulfonamide drugs alone.

I should like to emphasize what Dr. Saphir and Dr. Theobald mentioned about the danger of sensitizing the patient. A small amount of the drug may be sufficient for this, and the patient may be handicapped in the future when sulfonamide drugs are urgently needed. Some people acquire sulfonamide fastness or, more correctly, bacteria responsible for the infection become resistant to sulfon-

amide drugs. In certain bacterial strains this is possible, and this, of course, proves a handicap to the the patient. However, even with due consideration of the complications, it is a small price to pay for all the benefits derived from the use of the sulfonamide drugs. Rational use of laboratory findings will decrease the occurrence and the severity of complications.

Concerning the patient mentioned by Dr. Theobald who had symptoms of tiredness, fatigue and lack of pep. A drug that depresses the bone marrow and produces changes in various tissues, as mentioned in my paper, is likely to keep the patient below par for a long time, especially if he has been previously sensitized.

In answer to Dr. Salinger, I believe that nausea and vomiting following the administration of a sulfonamide compound should be attributed to the toxic reaction to the drug.

What is the explanation of the late infections following rhinoplasty in patients receiving sulfonamide drugs? Let us consider how these drugs act. There have been various hypotheses. According to one, the resistance of the patient is stimulated; this idea has been shown to be correct. The present concept is that the growth of bacteria is inhibited temporarily so that they do not multiply. Thus, if sulfonamide therapy is stopped too soon the bacteria again begin to develop, sometimes with much greater virulence than before, because the body did not have an opportunity to acquire immunity responses in the absence of the stimulus of the infection. That explains why in some patients insufficient treatment may be injurious and may be followed by a more virulent infection than at the onset.

The External Ear and Drum Membrane in Otosclerosis. Presented by Dr. Frank Wojniak.

Although the physical signs and symptoms in otosclerosis are meager, there have been mentioned in the literature such purely physical symptoms as lack of cerumen, enlargement of the lumen of the external auditory canal, atrophy of the skin of the canal, loss of its sensitivity or of the tickling reflex, loss of the cough reflex, loss of the vascular reflex, Schwartze's sign, abnormal thinness and transparency of the drum membrane, increased mobility of the pars tensa of the drum membrane and reduced or absent mobility of the handle of the malleus.

A careful comparative study of the external auditory meatus and the tympanic membrane was carried out with 100 patients with otosclerosis and 100 controls. The diagnosis of otosclerosis was based on the history of progressive deafness of insidious onset without preceding or accompanying otitis media and on the findings of a conductive form of hearing impairment with intact and essentially normal tympanic membrane and patent eustachian tubes.

The "controls" comprised 70 patients with normal hearing and 30 patients with forms of deafness other than otosclerosis. The latter consisted mainly of patients with nerve deafness; patients with deafness due to a pathologic condition in the middle ear or in the eustachian tubes were not considered suitable for this investigation.

Of the 100 patients given a diagnosis of otosclerosis, 53 were subsequently operated on. A satisfactory view of the stapes foot plate through the binocular dissecting microscope was obtained in 31 of the patients operated on. In every case, bony ankylosis of the stapes to the margin of the oval window was observed, and in some cases the entire stapes foot plate was replaced by solid bone continuous with the margins of the oval window.

The data obtained in the course of this investigation can be briefly summarized as follows:

1. The size of the external auditory canal in patients with otosclerosis is generally larger than that of normally hearing subjects, but coincides closely with that of patients suffering from other forms of deafness.

2. There appeared to be no relation between the amount of cerumen and deafness or normal hearing.

3. The skin in the external canal appeared to be atrophic as often as normal in patients with defective hearing, regardless of the type of deafness. Only 12.8 per cent of the normally hearing patients showed signs of atrophy.

4. The sensitivity of the skin, or the so-called tickling reflex, showed no appreciable variations between patients with otosclerosis and controls.

5. The cough reflex appeared to be of no diagnostic significance. It was elicited as frequently in patients with otosclerosis as in those with other forms of deafness or with normal hearing.

6. The drum membrane seemed to be thinned abnormally only slightly more frequently in otosclerosis than in other forms of deafness.

7. There was no marked variation in the vascular reflex of patients with otosclerosis and in those with other forms of deafness; one could say, however, that in normally hearing subjects this sign was more readily elicited.

8. Schwartze's sign appeared to be highly suggestive of otosclerosis, being present in 21 per cent of patients with that disease. However, it was present in 10 per cent of those with other forms of deafness, and in 4.2 per cent of the patients with normal hearing.

9. Mobility of the handle of the malleus appeared to be absent in 47 per cent of patients with otosclerosis as compared with 23.3 per cent of those with other forms of deafness, and 14.2 per cent of those with normal hearing.

10. The difference in the mobility of the pars tensa of the drum membrane between the three groups studied was negligible.

Concrete evidence in the way of readily demonstrable physical signs and symptoms is difficult to obtain, and when obtained its interpretation is dependent on the individual examiner to a great extent. Many of these signs, such as the atrophy of the skin or the thinness of the drum membrane, are of necessity merely visual impressions and, as such, are subject to wide variations with different observers. For this reason, significance of any one physical sign or symptom, or even a combination of several, may be doubtful or misleading.

It would appear from the present investigation that the external ear and the drum membrane have not a great deal to offer in the diagnosis of otosclerosis. Atrophy of the skin of the external auditory canal, and abnormal or unusual thinness of the drum membrane appear to be more frequent in persons who are deaf than in persons with normal hearing, but no more frequent in otosclerosis than in other forms of deafness. Except for Schwartze's sign, which is present twice as often in patients with otosclerosis as in patients with other forms of deafness, and five times as often in patients with otosclerosis as in persons with normal hearing, and the apparent absence of mobility of the handle of the malleus in a greater proportion of persons with otosclerosis than of the controls, there is nothing characteristic in the external ear and the drum membrane in otosclerosis to help in its differentiation from other forms of deafness.

DISCUSSION

DR. HANS BRUNNER: I think that this is an excellent and timely paper. I agree that there is actually no finding of the drum or the external canal which would permit one to make or to exclude definitely the diagnosis of otosclerosis. I might add that microscopic studies of these parts of the temporal bone in cases of otosclerosis furnish the same result. I was, however, surprised to learn that impacted cerumen occurs in persons with otosclerosis about as frequently as in persons with normal hearing. I have always had the impression that impacted cerumen was comparatively infrequent in otosclerosis, but apparently my idea was not correct.

In regard to Schwartze's sign, Dr. Wojniak may be interested in the findings of the late Dr. Schnierer (*Monatschr. f. Ohrenh.* **58**:965, 1924) who also noted this symptom not only in persons with otosclerosis but also in persons with normal hearing and in persons with other types of deafness, particularly deafness resulting

from congenital syphilis. Dr. Schnierer also investigated Schwartze's sign after injecting epinephrine through the eustachian tube into the tympanic cavity. He found that the red color usually persisted under these circumstances. Exceptionally, the red color disappeared; this, however, occurred in a person with normal hearing and not in a person with otosclerosis. This finding would indicate that the blood vessels which cause the redness of the promontorium do not respond to epinephrine. They cannot, therefore, be the common blood vessels of the tympanic mucosa; there must be abnormal blood vessels. Dr Schnierer presented microscopic data in a case of this type. The specimens were taken from a man aged 23, who was observed by Professor Alexander. He had advanced otosclerosis and a typical Schwartze sign. His five brothers and sisters were deaf-mutes. After the injection of Schleich's solution into the nasal septum the patient suddenly died. Necropsy revealed a status thymicolymphaticus and nephritis.

In this case there was an advanced otosclerosis which occupied the entire lateral wall of the internal ear. The otosclerotic focus was characterized by two findings: It extended to the mucosa of the tympanic cavity, the blood vessels of which were markedly dilated, and the otosclerotic focus contained large blood vessels indicating definite activity of the disease. In this case Schwartze's sign indicated not only otosclerosis, but an active otosclerosis which approached the tympanic mucosa and caused dilatation of the blood vessels of the mucosa. Although the findings in 1 case do not allow general conclusions to be drawn, these findings do explain three clinical observations concerning Schwartze's sign:

1. Schwartze's sign does not appear in all cases of otosclerosis; it appears only in instances of active otosclerosis.

2. Schwartze's sign may be present in a case of otosclerosis but may disappear when the activity of the disease subsides.

3. Schwartze's sign does not respond to epinephrine, because the newly formed blood vessels of the otosclerotic focus do not contain vasomotor nerves.

DR. FRANK WOJNIAK: We found impacted cerumen in 2 cases of definitely proved otosclerosis.

Directory of Otolaryngologic Societies *

INTERNATIONAL

First Pan-American Congress of Oto-Rhino-Laryngology and Bronchoesophagology

President: Dr. Gordon B. New, Mayo Clinic, Rochester, Minn.
Secretary: Dr. Chevalier L. Jackson, 255 S. 17th St., Philadelphia 3.
Place: Palmer House, Chicago. Time: Oct. 17-19, 1946.

NATIONAL

American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. J. Mackenzie Brown, 1136 W. 6th St., Los Angeles.
Secretary: Dr. Fletcher D. Woodward, 104 E. Market St., Charlottesville, Va.

American Academy of Ophthalmology and Otolaryngology

President: Dr. Gordon B. New, Mayo Clinic, Rochester, Minn.
President-Elect: Dr. Alan C. Woods, Johns Hopkins Hospital, Baltimore 5.
Executive Secretary-Treasurer: Dr. William L. Benedict, 100–1st Ave. Bldg., Rochester, Minn.
Place: Palmer House, Chicago. Time: Oct. 13-18, 1946.

American Broncho-Esophagological Association

President: Dr. Robert M. Lukens, 1923 Spruce St., Philadelphia.
Secretary: Dr. Paul Holinger, 700 N. Michigan Ave., Chicago 11.

American Laryngological Association

President: Dr. Frank R. Spencer, Physicians Bldg., Boulder, Colo.
Secretary: Dr. Arthur W. Proetz, Beaumont Bldg., St. Louis.

American Laryngological, Rhinological and Otological Society, Inc.

President: Dr. Harry W. Lyman, 906 Carleton Bldg., St. Louis.
Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester 7, N. Y.

SECTIONS:

Eastern.—Chairman: Dr. Robert F. Ridpath, 18th and Chestnut Sts., Philadelphia.
Southern.—Chairman: Dr. Walter T. Hotchkiss, 541 Lincoln Rd., Miami Beach, Fla.
Middle.—Chairman: Dr. Oliver E. Van Alyea, 135 S. La Salle St., Chicago.
Western.—Chairman: Dr. Colby Hall, 1136 W. 6th St., Los Angeles, Calif.

American Otological Society

President: Dr. William E. Grove, 324 E. Wisconsin Ave., Milwaukee, Wis.
Secretary: Dr. Gordon D. Hoople, 713 E. Genesee St., Syracuse, N. Y.

American Otorhinologic Society for the Advancement of Plastic and Reconstructive Surgery, Inc.

President: Dr. Alfred Schattner, 115 E. 61st St., New York.
Secretary: Dr. Norman N. Smith, 291 Whitney Ave., New Haven, Conn.
Place: New York. Time: Nov. 14, 1946.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.